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A Revision of the Genus *Diastatops* (Libellulidae, Odonata) and a Study of the Leg Characters of Related Genera

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Introduction and Acknowledgements

The members of the genus *Diastatops* are distinguished from all other Libellulidae by the possession of eyes which are completely separated—a character indicated by the generic name. These insects may be separated from all other members of the family, except the species of the genera Pal-

popleura and Zenithoptera, also by an undulation near the base of the costal margin of the fore wing. The genus is also characterized by dense venation and deep coloration of the wings.

Until rather recently this genus was represented in collections by a very small number of specimens. However, collections made in British Guiana by L. A. and E. B. Williamson and B. J. Rainey in 1912 and along the Amazon and its tributaries by J. H. Williamson and J. W. Strohm in 1922, by S. M. Klages in the same year, and by A. H. Fassl from 1920 to 1922, contain rather long series of specimens of *Diastatops*.

In an attempt to determine the Amazonian material the late E. B. Williamson soon realized the need of a monograph of the genus and suggested its preparation to the author. For this purpose all available specimens were secured from Ris' collection, from the Academy of Natural Sciences in Philadelphia, the American Museum of Natural History in New York and from the Cornell University Collection.

Although the recognition of species was comparatively easy, difficulties were encountered in naming the forms. Six specific names had been proposed in the genus—*dimidiata*, *marginata*, *obscura*, *pullata*, *fuliginea* and *tincla*. With the exception of *dimidiata* and *marginata* applied since the time of Fabricius to the same clearly distinct species, the exact status of none of these names could be determined without information concerning the specimens described by Burmeister and Rambur. Such essential information was not available in literature and no method of securing it from the specimens in Vienna and Brussels was available to the author until in 1932 one of his students, Miss Elizabeth M. Heiss, made a trip to Europe and examined specimens in the Collection de Selys at Brussels. A set of excellent notes and drawings of the Ramburian specimens in the Musée Royal d'Histoire Naturelle revealed the synonymy of the names used by Rambur. At approximately the same date drawings and brief notes on Burmeister's type of *L. pullata* were received from the Naturhistorisches Museum in Vienna. Somewhat later specimens which had formed the basis of the *Diastatops* records by Kirby were received on loan from the British Museum. Finally, a visit to the Carnegie Museum at Pittsburgh, in December 1934, yielded a rather long series of specimens, including those upon which Calvert's records were based and a considerable number belonging to one of the new species. In the meantime, several additional specimens had been acquired for the Williamson Collection, now in the Museum of Zoology, University of Michigan, and these were sent to be included in the study. With this material before him the author undertook the preparation of a monograph of the genus *Diastatops*, and a study of the relationships of the genus to other Libellulid genera.

Because the veins and cells of the wings offer the most easily defined, and therefore, the most usable characters for separating species, a number

of areas of the wings were selected for intensive study. Within these areas counts were taken from all specimens studied. The summaries of the tabulations of these counts showing, as far as represented in the material available, the variation within species, are given under "Venational indices" in the description of the respective species. The variation in each of these characters for the genus as a whole is indicated in the author's description of the genus, and discussed under "Variation" (p. 228). The Comstock-Needham terminology of wing veins is used.

The measurements tabulated at the beginning of the study (length of wings and abdomens of specimens available for study in 1927) were made by the use of dividers, the points of which were first set at the ends of the line of measurement and then applied to a millimeter scale. All other measurements were made by the use of a millimeter scale carefully ruled on a narrow strip of thin, stiff cardboard, which was applied directly to the line of measurement. This method was found to be equal in accuracy to the method of using dividers, was more rapid and involved less liability of damage to the specimens. The length of the abdomen was measured on the side, from the base to the tip of the appendages. The lines along which the measurements of the wings were taken are indicated in Pl. I, fig. 2 (p. 230). Measurements of the length of the wings and abdomen were made with the unaided eye, and were recorded to the nearest half unit (millimeter). Those of the legs, the pterostigma and the widths of the rear wing were made under a binocular microscope, and were recorded to the nearest half millimeter with indication of less (<) or greater (>) if such variation from the half unit was apparent, except the widths of the wing which were estimated to the nearest quarter unit. The measurements given for the legs and the pterostigma are based upon a limited number of average sized specimens. The recorded widths and ratios (of length to width) of the rear wing for each species are based upon measurements of two to four specimens of each sex, including those with maximum and minimum (and, in the more variable or best represented species, average or intermediate) lengths of rear wings.

The collection from which every specimen studied was obtained is indicated under "material studied" for each species. In accordance with a statement accompanying the specimens when they were sent, paratypes of *emilia* and *intensa* from the Ris Collection will be deposited in the Williamson Collection and in the collection of the author. Most likely duplicates from all of the more extensive series will be deposited in the collection of the author.

The author wishes to acknowledge his indebtedness and express his appreciation to all who have assisted in this work. He is especially indebted to the late E. B. Williamson, who suggested the study and gave considerable assistance through criticism and advice during the early stages of the

work. He wishes to extend his thanks to the following who have secured the loan of specimens for study, or have furnished information concerning specimens, records, localities, etc.: Miss Elizabeth M. Heiss, M. Antoine Ball, who assisted Miss Heiss in her examination of specimens at Brussels, Prof. E. J. Kohl, who made some of the photographs used in the plates, Dr. P. P. Calvert, the late Dr. F. Ris, Mr. Nathan Banks, Dr. Hugo Kahl, Mr. D. E. Kimmins, Dr. Erich Schmidt, Dr. H. Zerny, Mrs. Leonora K. Gloyd, and Mr. F. M. Gaige.

To Professor W. H. Wellhouse under whose direction this study has been completed and the manuscript prepared and whose helpful advice and suggestions on this and other investigations over a period of years have been most valuable, the author here expresses his sincere thanks and appreciation.

Historical Review

The genus *Diastatops* was erected by Rambur in 1842, for three species—*fuliginea* and *tincta* which were described as new, and *Libellula pullata* Burmeister. *Fuliginea* was apparently intended as a new name for the species which Burmeister had referred to *Libellula obscura* Fabricius. Although Rambur cited the description of *obscura* by Fabricius under *fuliginea*, he placed a question mark after it, adding (“L’*Obscura* de Fabricius paraît plutôt se rapporter à la *Fulvia* de Drury”). However, all later authors have disagreed with Rambur and have considered *obscura* Fabricius to be the species so-called by Burmeister. Rambur’s description of *fuliginea* is less complete than his descriptions of *tincta* and *pullata*, and he did not list any specimens which he had seen. Nevertheless, his description must have been based upon a specimen, as it contains considerable data not given in Burmeister’s description of *obscura*. There is a specimen in the Collection de Selys, bearing the label “*fuliginosa*,” which Ris considered to be Rambur’s type. From Rambur’s description—“un peu rougeâtres à la base des postérieures où les aréoles sont plus nombreuses que chez la *Tincta*, mais un peu moins que chez la *Pullata*”—it appears that *fuliginea* is a synonym of *pullata*! This view is supported by the specimen in the Collection de Selys. Concerning this specimen Miss Heiss wrote, “areas of coloration dim but can be distinguished on microscope as faintly coral colored. Secondary reticulation most closely resembles photo #4 (*pullata*); it seems to be identical. It is not like #1 which is marked ‘*obscura*.’”

Furthermore, it appears that *tincta* is a synonym of *obscura*. Rambur’s description of the wings of this species clearly indicates *obscura* characters—“Ailes courtes, d’un brun roussâtre foncé, ayant un reflet d’un vert métallique en dessus, d’un bleu violet en dessous; . . . aréoles nombreuses, presque égales.” Concerning the type specimen of *tincta*, now also in the Collection de Selys, Miss Heiss wrote, “No areas of secondary reticulation or coloration of veins (*obscura* group).”

After noting the significance of the name chosen by Rambur for this genus and reading his comment, "Ces espèces présentent une anomalie dans les Libellulines par leurs yeux à fait séparés," one may well wonder why he referred *Libellula dimidiata* Linné to Palpopleura. Perhaps, the specimen upon which his study was based was so damaged that this character was not easily seen as he noted "(Mâle très-détérioré)". The distribution of the species had no significance for Rambur, even if he had known it (although his specimen carried no locality label, both Linné and DeGeer had given America as the origin of their material), as he included the American species *fasciata* Linné (*americana* Fabricius), now placed in Zenithoptera, in the otherwise old world genus Palpopleura.

Thus it is seen that all of the previously described species recognized as valid in this paper were already described before Rambur erected the genus. Linné had described *dimidiata* in 1758, Fabricius *obscura* in 1793 and Burmeister *pullata* in 1839. DeGeer described a species under the name *Libellula marginata* in 1773 but this was placed as a synonym of *dimidiata* by Fabricius (1793) and has been so considered since that time.

Burmeister possessed material and gave descriptions of the three species. He placed them in a group with three others, *fulvia* Drury, *fluctans* Fabricius and *fasciata* Linné (*americana* Fabricius). His grouping of the species of Libellulidae, considered by him as the genus Libellula, was based upon a considerable number of characters which are still used in the arrangement of Libellulid genera, such as relative length and width of the rear wings, density of venation, shape of the triangle and the number of cells following the triangle of the fore wings.

None of the authors before Rambur had mentioned the characteristic divided eyes of the species or the undulate costal margin of the fore wings common to these and related species. Nor had Burmeister made use of the latter in his grouping of species. Thus, only one of the three species (*fasciata*) grouped with the Diastatops species has an undulate costal margin. The remaining species listed by him which possess this feature (now in the genus Palpopleura), were placed with certain species lacking it, in another, rather widely separated, group.

For many years after the publication of Burmeister's and Rambur's works, little was added to the knowledge of Diastatops. Erichson published records of *dimidiata* and *tincta* from "Guiana" in 1848, but *dimidiata* had been recorded from Surinam by Burmeister. The name "*Diastatops fenestrata*, new species," occurs in a table of species in a paper published by Hagen in 1835. However, no description was given and the name does not appear elsewhere in literature, except a citation of it as a synonym of *D. dimidiata* by Hagen (1875). In the "List of South American Neuroptera" attached to the Synopsis of the Neuroptera of North America (1861) Hagen gave citations and summaries of the distribution of four species.

He considered *fuliginea* a synonym of *obscura*. The localities which he listed for the different species were compiled from the references cited, except for *pullata*. The distribution given for this species, "Brazil; Pernambuco; Peru; Moxos," was probably based upon specimens which Hagen had seen, as these two localities were not listed by Burmeister or Rambur. Moreover, the "Aus Surinam" quoted by the former for this species was omitted. There is an exclamation point (!), an indication that he had seen specimens, after each of the four species. These records, with some change of form to indicate more clearly the exact localities referred to by the successions of country, province and city names, were repeated in the "Synopsis of the Odonata of America" by Hagen, published in 1875.

In 1868 Brauer published a classification of the Libellulidae, characterizing and grouping the 40 genera which were recognized at that time. His "III Gruppe" was composed of Diastatops and Palpopleura. The group was defined as follows: "Costalrand vor dem Nodus mit einer Einbuchtung. Cellula cardinalis dreieckig, Klauen mit einem Zahn." His description of Diastatops was more complete than the original by Rambur, being an enumeration or description, one by one, according to an outline followed for all genera, of the characters most useful in separating and defining Libellulid genera. No specific descriptions or characterizations were given, but the four species listed by Hagen in 1861 with the localities (but not the citations) for each, were copied without change from that author.

In his "Revision of the Subfamily Libellulinae" published in 1889, Kirby gave a detailed enumeration of the characters of 88 genera, 40 of which were described as new. With this increase in the number of recognized genera many additional characters of generic rank were noted. The description of Diastatops was extended (from those by Rambur and Brauer) to include such of these characters as are applicable to the genus. An examination of the range in number of veins and cells in different areas of the wings given by Kirby, indicates that he had studied specimens of more than one species in drawing up his description of the genus. However, the number of specimens studied was rather limited. *Libellula pullata* Burmeister was designated as the type of the genus, but there was no further mention of species. Little was added to Brauer's classification of "III Gruppe," except that a new genus, Potamothemis was erected for the American species previously placed in Palpopleura. In his "Synonymic Catalogue of Neuroptera Odonata" published the following year he gave a complete synonymy of all species of Diastatops. The views of Hagen (1861, 1875) were adopted without change. Only the original description was cited for each specific name, except for *dimidiata* and *pullata*; for these Rambur was also cited. "S. America" was given as the distribution for *dimidiata*, *tincta* and *pullata*, Brazil for *obscura*. Records of *dimidiata*, *ob-*

scura and *pullata* from the Amazonian region, based upon collections by Austen, were published by Kirby in 1887. It was stated that *obscura* and *pullata* were very abundant and were always found together by Austen, and that both Austen and M'Lachlan thought these were the same species. However, at least one of the specimens from this lot called *pullata* by Kirby belongs to one of the new species described in this paper (*estherae*).

Soon after the appearance of Kirby's Revision, Karsch published a classification of the "Libellulinen" (1889). This paper is essentially a critical comparison of the classifications proposed by Brauer and by Kirby. However, as these authors agreed upon the composition and relative isolation of the group containing Diastatops and Palpopleura Karsch's remarks on this group were limited. He pointed out that Kirby's genus Potamothemis was a synonym of Zenithoptera which had been erected by Selys in 1882. In a later paper (1900) dealing with the fauna of the Moluccas and Borneo, he gave a new classification for the Libelluliadae (restricted by the separation of the Cordulidae) to subfamilies. Four subfamilies were recognized; one of these was the Palpopleurinae, having the costal margin of the fore wing sinuate before the nodus, and containing the genera Zenithoptera, Palpopleura and Diastatops. This was, of course, merely, the "III Gruppe" of Brauer raised to subfamily rank.

Five specimens of Diastatops from Brazil were among the material studied by Calvert in the preparation of his paper on the Neotropical Odonata fauna (1909). These were referred to three species—*pullata*, *fuliginea* and *tincta*. These appear to be the only records for *fuliginea* and *tincta*, other than the original Ramburian descriptions, based upon actual specimens. Examination of Calvert's specimens in the course of the present study shows that his *fuliginea* included a male *pullata* and a female *obscura*, and that the specimens referred to *tincta* and *pullata*, respectively, really belong to *obscura* and a new species (*intensa*).

The references to *tincta* in morphological studies by Needham and Anthony (1903) and Butler (1904) include no information concerning the specimen studied. From a statement by Butler concerning the source of her material, however, one may well infer that the specimen belonged to the Hagen Collection, being one of "some specimens loaned by the Museum of Comparative Zoology, which were at that time in his (Needham's) possession."

A study of the Diastatops material of the Collection de Selys, which included Rambur's specimens of *fuliginea* (?), *tincta* and *pullata*, led Ris (1910) to the conclusion that, in addition to the clearly distinct *dimidiata*, only one species exists. However, when the rich lot of material collected by the Williamson expedition to British Guiana in 1912 and the field notes made by E. B. Williamson were studied, this decision was reversed.

Ris' description of the genus is very complete; it includes not only a more detailed enumeration of venational characters than had been given by previous authors, but also a thorough discussion of the body and leg characters. His specific diagnoses include brief descriptions of male and female genital characters and rather extensive notes on the variation in the extent of areas of secondary reticulation and in the coloration of veins and wing membrane, especially the variation illustrated by specimens from different localities. Measurements (length of abdomen, rear wing and pterostigma) are given for many specimens. This great monographic work on the "Libellulinen" includes a thorough study of the characters and relationships of genera. Ris arranged the 120 genera which he recognized as valid into ten groups. His "III Gruppe" contains in addition to the Palpopleurinae of Karsch the genus *Perithemis*, although he noted, "Die Stellung der Gattung im System ist zweifelhaft; sie könnte auch zur VII Gruppe (*Leucorrhinia*, *Celithemis*, etc.) gestellt werden."

Subsequent references to *Diastatops* consisted mostly of records of *obscura* and *pullata* without descriptive or ecological notes (Navas, 1921, 1923—2 papers, 1924; Sjostedt, 1918; Ris, 1928), or referred to the group in discussions of faunae of other regions (Ris, 1921; Bartenev, 1915, 1929). In several of Williamson's papers on other genera (1915, 1916, 1917) records of the capture of one or more species of this genus were included and in the accounts of the University of Michigan-Williamson Expedition to Brazil (1922; J. H. Williamson, 1923) a number of habitats of *Diastatops* was described. However, the field notes from the several Williamson expeditions are quoted extensively in this paper, as many of the specimens are discussed for the first time herein.

Although Longfield (1929) listed *obscura* and *pullata*, her record of *obscura* was based upon Calvert's *tinctoria* determination discussed above and some of her *pullata* specimens proved to belong to *intensa*. Her note concerning the differences in coloration found in her material suggests that still another species was represented.

Navas (1923) recorded a specimen from Piquette, Santa Fe (Argentina), under the name "*Diastatops fuscata* F." This name, however, must be a lapsus calami because no other reference to it can be found in the Odonata. Lack of data other than the date, locality and collector prevents its determination although *intensa* is the only species of *Diastatops* which has been taken so far to the south.

The published illustrations of *Diastatops* are both poor in quality and few in number. Rambur's illustration of *pullata*, showing the venation in one pair of wings and the course of the principal veins in the other is an inaccurate artist's drawing. Ris' photographic illustration of the wings of *pullata* is indistinct and shows very little of the venation. (I have not seen Drury's figure.)

Ris' classification of Libellulid genera was adopted with a few minor changes by Tillyard (1917), who divided the group into eight tribes; his tribe Palpopleurini is Ris' "III Gruppe."

In a study of the venation of the Libellulidae, based, for the most part, upon the photographs of wings in Ris' Libellulinen, Needham and Broughton (1928) gave a new arrangement of genera. Diastatops was placed in the tribe Celithemini, characterized chiefly by having the bisector of the anal loop nearly straight (the outer end forming an angle of less than 30° with the basal portion) and containing a "preponderance of forms with colored wings" and copious venation. Twenty genera were included in the tribe but natural subgroups were recognized. "*Diastatops*, *Zenithoptera*, and *Palpopleura* have long been set apart on the possession of a costal vein that is undulate before the nodus. This alone is hardly a character of tribal value. It fails in species of *Palpopleura*. Ris included *Perithemis* with these three genera and on venational evidence we add others."

The relatively frequent suppressions and resurrections of nominal species indicate that Diastatops would have been a "splitters' and lumpers' paradise" had an abundance of material been available to students of the Odonata. The numerous mistakes in the application of specific names have been due to the inadequacy of Rambur's diagnoses of species and the inaccessibility of his material to most authors. The present interpretation of the names used by authors is possible because much of the material listed by Kirby, Calvert, Ris and Longfield, together with critical notes and drawings of the specimens studied by Burmeister and Rambur, has been brought together for comparative study.

Distribution

The known distribution of Diastatops extends from the lower Magdalena (Sevilla, Colombia) and Orinoco (Cano d'Vagre, Venezuela) basins to the lower Parana basin (Sante Fe, Argentina). Although there are no records for southern Colombia and Venezuela and for the great central plateau of Brazil this is probably due to inadequate collecting. The localities along the Amazon from which we have records of Diastatops form an almost unbroken chain of the river ports from Belém to Iquitos. At least three lines of distribution may be seen to lead from this chain of records to the Rio Paraná. These lines consist of the Tapajóz-Paraguay, the Madeira-Guapore-Paraguay, and the Madeira-Mamoré-San Miguel systems. However, as indicated above, these lines are probably only apparent paths of distribution created by the vagrancies of collecting through an area in which the occurrence of the genus is continuous. There is an almost continuous line of records along the coast from the mouth of the Magdalena to Rio Grande do Sul, and there are also records from the minor river systems in the interior of eastern Brazil.

Map of South America, showing locations at which specimens of Diastatops have been collected.—1—Alegre. 2—Alta Mira. 3—Bahia. 4—Baurú. 5—Belem. 6—Benevides. 7—Boqueirao. 8—Cachoeira. 9—Cano d'Vagre. 10—Carvoeiro. 11—Cayenne. 12—Coary. 13—Corrientes. 14—Formosa. 15—Fortaleza. 16—Georgetown. 17—Iquitos. 18—Itabapua. 19—Itaituba. 20—Manacapuru. 21—Manáos. 22—Maués. 23—Miritituba. 24—Moura. 25—Nova Olinda. 26—Obidos. 27—Pebas. 28—Pied Saut. 29—Porto Velho. 30—Progresso. 31—Recife. 32—Santa Cruz. 33—Santa Fé. 34—Santarem. 35—Sao Antonio. 36—S. Lorenzo. 37—Sao Luiz. 38—Sao Paulo de Olivenca. 39—Sapucay. 40—Sevilla. 41—Taperinha. 42—Teffe Ega. 43—Tonantins. 44—Tumatumari. 45—Uacaryzal. 46—Uassa Swamp. 47—Victoria. 48—Villanova. 49—Wismar.



The center of distribution of the genus is the middle Amazonian region—from the Rio Tapajóz to the Rio Japura. All of the known species, with the possible exception of *dimidiata*, occur in this area, and three of them—*emilia*, *maxima*, and *nigra*—are now known only from this region.

None of the three natural groups of the genus is confined entirely to the Amazon. In the *obscura*-group, *maxima* and *nigra*, known from only one and two localities respectively, very likely occur only here, whereas *obscura* is the most widely distributed species of the entire genus. Its known range extends from Colombia to Paraguay and eastern Brazil. However, it has not been taken on the upper Amazon.

Of the *pullata*-group only *emilia*, found at three localities on the Rio Tapajóz (all of these probably close together and rather close to the mouth of the river), has not been found outside of the middle Amazonian region. However, *estherae* is known from only one locality outside of this area—southern British Guiana. This record indicates a range extending far up the Rio Jaupery and/or Rio Branco basins from the Manáos district where this species is comparatively common. The available records indicate that the distribution of *intensa* along the Amazon is limited—probably including only the vicinity of the Rio Tapajóz and, thus, being identical with that of its near relative, *emilia*. However, *intensa* is not confined to this area but extends by the Rio Tapajóz-Paraguay “pathway” into the edge of the south temperate zone. Here, it occurs over a wide area—Argentina to Rio de Janeiro—and reaches much farther to the south than any other species of the genus. *Pallata* has been taken throughout the length of the Amazon and along many of the principal tributaries, especially those from the south. It is found also along the coast in either direction from the mouth of the Amazon, at least as far as British Guiana to the north and the State of Bahia to the south.

Dimidiata, which stands alone in the third group of the genus, is primarily a coastal species; all the records, except those from the Rupununi River and the Parana de Buyassu, are from localities within a few miles of the sea.

Although further collecting will no doubt extend the known range of several, if not of all, species, it is probable that the limits of distribution of the genus are approximately matched by the outlying records. However, the discovery of *Diastatops* in Central America or even in Mexico would not be a complete surprise in view of the occurrence there of other groups centered in the Amazonian region and the presence of one species of *Diastatops* as far south as 30° and of another to about 25° south latitude. Of special interest in this respect is the recent capture of specimens of *Zenithoptera*, the most closely related group (both in structure and distribution) to *Diastatops*, in Nicaragua.

The distribution of the species has been determined as accurately as

possible by mapping the published records and those of the material studied. Considerable difficulty was encountered in locating many of the place names given by collectors and several of these could not be mapped with certainty. Many of the cities and villages of Brazil (and other South American countries?) have local names which are entirely different from the "official" names used on maps. Furthermore, many places appear to be known by two or more names, and certain names differ considerably in spelling on the maps consulted. The collectors of *Diastatops* specimens, in addition to using such variants without comment, have frequently given as the locality of a capture the name of a cattle ranch or an estate which is not shown on any map and many of which are perhaps no longer in existence.

Most of the places mapped have been located by means of the maps in the atlas of the Century Dictionary, those in Stiehler's Atlas of Modern Geography, the National Geographic Society map of South America, and a "Carta Geographica do Brazil" published by the "Club de Engenharia" (of Brazil?) and furnished me by Mrs. Concha Romero James, Chief of the Division of Intellectual Cooperation of the Pan-American Union. Information concerning the location or identity of certain specific place names was given me by Mrs. James, Dr. P. P. Calvert, Dr. Hugo Kahl, Dr. J. Chester Bradley, and Mrs. Leonora K. Gloyd.

The following place names could not be found or identified: Barreiras (Rio Tapajóz, Pará), Bota Io Pinto (Pará?), Carepi, Costa Aguaray (Paraguay), Cumaral (Colombia), Gaitra, Lapango (N. Argentina), Massuary, Moxos, and Turaty.

The Genus *Diastatops*

Diastatops Rambur, 1842, Ins. Nevr.: 135; Brauer, 1868, Verh. Zool. Bot. Wien, **18**: 364, 715; Kirby, 1889, Tr. Zool. Soc. Lond., **12**: 257, 271; Carpenter, 1897, Sci. Proc. Roy. Dubl. Soc., **8**: 442; Calvert, 1901, Ent. News, **12**: 325; Ris, 1908, Denkschr. Med.-Natur. Ges., **13**: 332; 1909, Coll. de Selys, **9**: 16, 23; 1910, Coll. de Selys, **11**: 307, 311, 313, 317; 1911, Coll. de Selys, **12**: 492; Bartenef, 1915, Faun. Russ., **1**: (1): 5; Schmidt, 1915, Zool. Jahrb. Anat., **39**: 44, 52, 73; Ris, 1916, Coll. de Selys, **16**: (2): 1109; Tillyard, 1917, Biology of Dragonflies: 265; Ris, 1921, Ann. S. Afr. Mus., **18**: 402; Williamson, 1922, Ent. News, **33**: 243; Navas, 1923, Neur. Colombianos: 265, 266; Williamson, 1923, Mich. Acad., **3**: 404, 418; Needham and Broughton, 1927, Tr. Am. Ent. Soc., **53**: 162, 173, 185, 188, 189; Bartenef, 1929, Zool. Jahrb. Syst., **56**: 372.

GENOTYPE

The type of the genus *Diastatops* is *Libellula pullata* Burmeister, as designated by Kirby in 1889.

CHARACTERS OF THE GENUS

Original Description.—Tête ayant le front très-saillant et les yeux non contigus. Ailes ayant les principales nervures très-saillantes, et le bord costal échancré, avec le réseau extrêmement serré; pièce sous-stylaire chez les mâles au moins aussi large que longue, largement échancrée, plus étroite à la base. Pattes grêles, ayant des cils très-longs, presque comme chez les *Calopteryx*. Six ou sept rangées d'aréoles discoïdales.

Ces espèces présentent une anomalie dans les Libellulines par leurs yeux tout à fait séparés; elles se rapprochent cependant beau coup par leurs ailes, de celles du genre *Polyneura*, qui ont les yeux contigus, mais elles ont les nervures plus saillantes, les nervules plus sensibles, et les ailes des trois espèces que je décris sont entièrement d'un brun fuligineux plus ou moins foncé. Les femelles me sont inconnues.

Author's description.—Head rather small; eyes separated by about one-third their width in dorsal view. Frons projecting forward rather conspicuously; cephalic surface flattened, the flattened space divided into two more or less circular areas by the furrow; flattened areas and dorsal surface rugose; furrow rather wide and deep. Vertex wide; cut off rather straight in front; apex bicuspid; coarsely punctate or rugose. Occiput trapezoidal (instead of the usual triangular shape in other genera of Libellulidae); smooth and shining, sometimes sparsely and finely punctured. Rear of head smooth, shining black, concolorous. Head without distinct color markings. Labium varying from dull cream, through light yellowish browns to dark reddish brown; however, the particular color in any specimen appears to be due to conditions affecting its drying as there seems to be no constant specific differences and in most cases the original color appears to have been lost. Mandibles greenish or olive brown at base, red or reddish brown at apex. Labrum black or dark brown. Face (clypeus) dull greenish or olive brown. Cephalic surface of frons dark brown or black, usually with a slight purplish sheen, dorsal surface dark iridescent or metallic purple (bright red in *estherae*). Vertex and occiput metallic purple. Face and vertex clothed with moderately dense black hairs; caudal margins of eyes and occiput fringed with long, rather dense, brown or yellowish hairs.

Lobes of prothorax very distinct; third lobe very large, erect, consisting of two semi-circular lobes, densely fringed with long hairs. A tuft of similar hairs on caudo-ventral angles of middle lobe; remainder of prothorax glabrous, or with very sparse, short, whitish hairs. Pterothorax rather small, slightly compressed; without distinct color markings. Entire thorax dark brown or black on dorsum, varying to light brown or olive gray on sides and below; with moderately dense pubescence, varying in color, more or less, with cuticle, from black above to light brown, or even tawny yellow near the legs and on the coxae.

Legs very long and slender, with conspicuous armature; light to dark brown, sometimes black, especially on feet, usually much lighter at base; all spines black except those in tibial comb which are frequently reddish.

Femora rounded beneath; with more or less distinct carinae on dorsal margins. Caudo-ventral margins with rows of spines more or less confused, the first with a rather distinct row of 10-14 spines and dorsad of this an incomplete row of shorter spines; second with two or three confused rows of very slender spines; third with a row of 15-20 fine spines, and just ventrad of this a row of less numerous, longer spines. Cephalo-ventral mar-

gins with a distinct row of spines of unequal length; the first with a row of four to six equally spaced spines in middle third or half of femur, gradually increasing in length outward, then following a space of about twice the usual distance a very long spine and at the apex of the femur a fine spine or hair of moderate length; the second with a row of eight to 12 spines, the first very small, sometimes only a short triangular tooth, spines in proximal half of row gradually increasing in length, those in distal half equal in length, at the end a more slender spine of moderate length; frequently a trace of a row of hairs just dorsad of the base of this row of spines; the third with a row of 10-16 spines, gradually increasing in length outward from the first short triangular "tooth," except near the end a very long, more widely separated spine and then a fine spine of medium length. Ventral surface of femora usually with a row of slender spines; dorsal surface frequently bearing a few fine, rather long, yellowish hairs, dorsal carinae, especially on second and third femora, with triangular, black teeth or serrations.

Tibiae flattened beneath and to a considerably less degree above; dorsal carinae serrate; teeth acute, decumbent, black. Tibial spines very long at base—one-third to one-half the length of the tibiae, gradually decreasing in length outward; more distal spines of each row frequently conspicuously shorter and more closely placed; caudo-ventral row containing approximately eight to 10 spines on first tibia, 12-17 on second and 13-19 on third; cephalo-ventral margin of first tibia with a row of about five spines on proximal half, followed by a "comb" of 9-12 flattened, somewhat curved, closely placed spines of about equal length on distal half; cephalo-ventral row on second tibia consisting of eight to 12 spines, that on third of 11-18.

Claws long and slender; tooth small, distad of middle.

Wings very broad; wholly or in large part dark; venation very dense and with a considerable degree of variation in the number of cross veins and cells even in the most definitive areas; a considerable development of well-defined sectors and planates in many parts of the wings. Costal margin of the fore wing undulate, having a broad arc-like emargination at or slightly less than half the distance to the nodus. Many antenodal cross veins (13-22 in fore wing, eight to 15 in rear wing), the last usually incomplete. Three to seven cells after the first in the costal postnodal region of the fore wing bisected by a longitudinal vein or with anastomosing cross veins in this area (except in *dimidiata*); eight to 17 postnodal cross veins in the rear wing. Many accessory bridge cross veins (usually two to eight or more). M_{1a} arising about one cell before the proximal end of pterostigma. M_2 rather weakly undulate; Rs smoothly curved. Rpl and Mpl well formed, subtending two to four rows of cells each. Arculus on first antenodal cross vein or slightly distad in fore wing, slightly distad of first to mid-

way between first and second in rear wing. M_{1-3} and M_4 arising separately from arculus or united for a very short distance in the fore wing, united for a slightly greater distance in the rear wing. Usually many supra-triangular cross veins (three to 11 in fore wing, one to four in rear wing). Triangle of fore wing widely distad (about five cells) of proximal angle of that of rear wing; distal side of both triangles concave; many celled (three to eight in fore wing, two to eight in rear wing). Cu_1 of fore wing strongly curved, approximately concentric to M_4 in distal two-thirds of its length; discoidal area of fore wing narrowed somewhat in proximal third, thence parallel to wing margin; usually five to 13 cells following triangle and five to eight rows in middle portion; in proximal portion of area in both wings well-defined transverse sectors divide the area into fields of two to four rows of cells. Cu_2 of fore wing two to four branched; all branches usually well-defined to the wing margin. Regularly one cubito-anal cross vein in fore wing; but sometime a second far distad of the first; usually two in the rear wing, sometimes one, more frequently three, or, rarely, even, four; the most distal one sometimes branched, or the area near the triangle containing a network of veins. No internal triangle in the fore wing, the area proximad of the triangle divided into two to four fields of two or more rows of cells each by transverse sectors arising from the anal vein; a branch arising from Cu_2 runs proximad to join A and form a more or less elliptical "loop" of about five to ten cells. Anal area of rear wing very broad; loop long and broad; outer angle well rounded; anal angle about on a level with the distal angle of triangle; gaff less than sole, frequently only two-thirds as long; bisector nearly straight, having an angle of 30° or less, arising about one-fifth or less of the distance from A_3 to A_1 , forked at the bend, the outer branch running to the outer angle of the loop; area proximad of the loop divided into long narrow fields of two or more cells (in width) by numerous sectors; usually a secondary loop (corresponding to or identical with the *patella* of Needham) of a few to many cells just proximad of the base of the loop. Pterostigma very large, reddish brown; membranule moderately large, smoky gray to dull black.

Abdomen rather short, slightly swollen at base; more or less spindle-shaped in the male, segments four to 10 triangular in cross-section; sides more nearly parallel in the female, also sides and venter rounded out more than in the male. Transverse carinae on segments 3 and 4. Segment 1 and, sometimes, anterior half of 2, black on dorsum; 2-3 red on dorsum, dull brown to olive green on sides and venter; 4-9 red on dorsum and sides, reddish brown below, margins and carinae sometimes black; 10 usually black, sometimes with more or less red.

Superior appendages rather small, each with a row of four to seven teeth below, very dark reddish brown or black; inferior appendage about two-thirds as long as superiors, caudal margin hollowed out, sides divergent or

sub-parallel, usually red or reddish brown with black margins. Male genitalia small; front lobe infrequently equal in length to hamule, usually less, caudal margin sinuate; hamule with strongly recurved hook on mesal margin, outer lobe not greatly developed; genital lobe equal to or greater than hamule in length, size and shape varying with the species, strongly margined; caudal margin of front lobe and margins of genital lobe fringed with moderately long hairs.

Appendages of female cylindrical; straight or slightly curved; apex acute, extending beyond tip of abdomen; very dark reddish brown or black. Margins of segment 8 in female turned down, not expanded; vulvar laminae small, scale-like, covered by folded down margins of segment 8.

Variation.—There is little color variation among individuals or species of *Diastatops*; in dried specimens, at least, no distinct color markings are evident. The colors most common in dried specimens are black, purple, red and various shades of brown. Teneral are lighter in color than mature specimens; the increase in intensity of coloration with age is most marked in the wings. Wings of teneral, even of the *obscura*-group, are rather transparent and the postnodal light areas are usually quite evident. In mature specimens (except of *dimidiata*) most of the wing membrane is opaque and the postnodal light areas are much less evident, even in many specimens of the *pullata*-group. The veins in the areas of secondary reticulation in mature specimens of the *pullata*-group are brilliant red, but in teneral they are bright yellow.

The most conspicuous and easily studied characters in *Diastatops* showing variation are found in wing venation. In order to study the variation within each species and, if possible, to discover characters useful in distinguishing species the numbers of cross veins, or of cells, in each of 16 different areas in the wings were tabulated.

The cross veins counted were the costal and subcostal antenodals, the costal and radial postnodals, the accessory bridge veins, the supra-triangular veins, all of which occur in both wings, and the cubito-anal cross veins of the rear wing. Cells were counted in the triangles of both wings, in the first row following the triangle of the fore wing, in the "loop" of the fore wing (a well defined, reticulated area corresponding to the second part of the row of cells subtending the subtriangle as described by Needham and Broughton), and in the patella of the rear wing (a reticulated area proximad of the base of the anal loop). The numbers of rows of cells were counted in the following areas: in both wings, between R_{pl} and R_s , between M_{pl} and M_4 , and between M_3 and M_4 ; in the rear wing, between Cu_2 and the outer branch of the bisector of the loop (A_2) at its origin and between A_2 and A_3 at the level of the forking of A_2 .

The location and general characteristics of these areas are indicated in Pl. I, fig. 1 (p. 230). The range of the variation (minimum and maximum

numbers) and the average (arithmetic mean) of each of the counts of cross veins and of cells are given for the respective species under "Venational indices" in the specific descriptions.

The number of antenodal cross veins which is usually rather constant in Libellulid genera and is frequently used for generic diagnoses, is highly variable in *Diastatops*. In the costal series of the fore wing the number varies from 13 to 25, but the greatest range within a species is from 17 to 25 (*pullata*) and the intraspecific range in the majority of species is only about one-half as great as the range of the genus. In the subcostal series of the fore wing the number for the genus as a whole varies from 12 to 22, that for *pullata*, again the most variable species, from 15 to 22, with slightly more than half of the range above the maximum number found in the other species (usually 17 or 18).

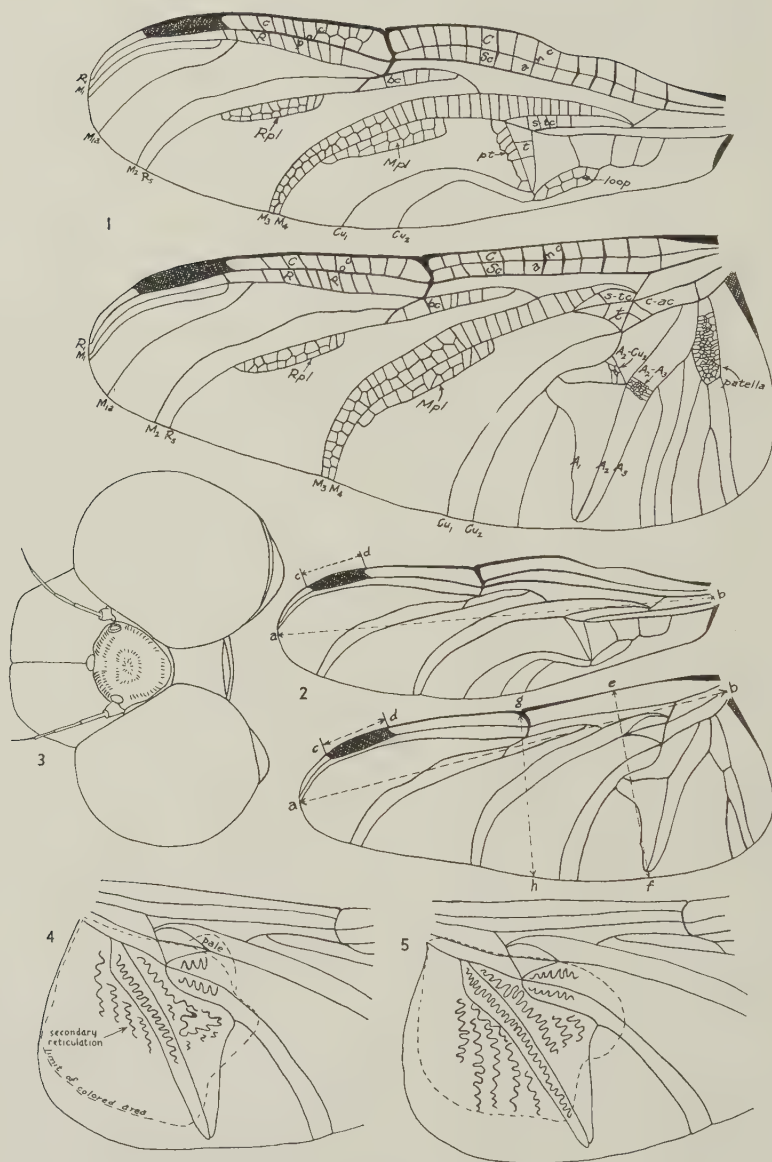
The numbers of antenodal cross veins in the rear wing are similar to those of the fore wing although the number of veins is less and ranges are more narrow. The generic range is from eight to 16 (costal series) or 17 (subcostal series), but the upper limit (in both series) for most species is 12. Thirteen (found in seven per cent of the fore wings and 12 per cent of the rear wings) is the maximum in *estherae*. The upper part of the generic range is again occupied by *pullata* in which approximately 90 per cent (fore wing) and 75 per cent (rear wing) of the wings examined contained 13 or more cross veins.

Because the cross veins in the proximal portion of the costal postnodal space of the fore wing anastomose in all species except *dimidiata*, they were excluded from the study of variation. In the radial series the number varies from five to 19 and the specific patterns of distribution are very similar to those of the costal antenodal series; *pullata* occupies approximately the upper half of the generic range and the other species the lower half, with an overlapping in only two units (11-12). The range for most of the species extends from seven or eight to 12.

The numbers of postnodal cross veins in the radial series of the rear wing are almost identical with those of the fore wing. In the costal series the ranges are somewhat different, most of them being slightly higher. That of *pullata* (12-19, average 15.78) is almost the same, but it is overlapped to a greater extent by those of *emilia* (11-15, average 12.55), *dimidiata* (10-14, average 12.59) and *estherae* (5-16, average 13.30—five cross veins were found in only one wing of 67 examined of this species, the range is otherwise 11-16).

The number of accessory bridge veins and of cross veins in the supra-triangular areas also reveals the great variation as well as the density of venation in this genus. In most genera in which these cross veins are present the number in either area is usually less than four, and rather constant. In *Diastatops* the number of accessory bridge veins varies from none

PLATE I



1. Wings of *Diastatops intensa* showing the principal veins and the areas within which counts of veins or cells were made for the study of variation. A₁, A₂, A₃—anal veins. A₂—A₃—rows of cells between A₂ and A₃ at level of forking of A₂. A₂—Cu₂—rows of cells between Cu₂ and the outer branch of the bisector of the loop (A₂) at its origin. anc—antenodal cross veins. bc—bridge cross veins. C—costal series of antenodal and postnodal cross veins. c-ac—cubito-anal cross veins. Cu₁, Cu₂—branches of the cubitus. loop—loop of the fore wing, a well-defined reticulated area corresponding to the second part of the row of cells subtending the triangle as described by

to 10 (fore wing) and 14 (rear wing), and that of supra-triangular cross veins from one to 23 (fore wing) and none to seven (rear wing). The intra-specific ranges are also rather wide. The greatest variation and also the largest numbers of veins in each of these areas are found in *estherae*, and a considerable proportion of the generic range in the number of supra-triangular cross veins is due to the variation in this species (6-23, average 11.96 and 2-7, average 4.39, respectively for the fore and rear wings), which greatly exceeds that of *dimidiata* (2-13, average 8.5 and 1-5, average 2.5), *pullata* (4-11, average 7.73 and 0-4, average 2.14) and the other species (in which the ranges are lower and more narrow). However, the number of accessory bridge veins found in *estherae* (3-10, average 6.54 and 5-14, average 8.45, respectively for the fore and rear wings) is only slightly greater than in *pullata* (3-9, average 6.28 and 3-12, average 6.83).

The number of cubito-anal cross veins in the rear wing of *Diastatops* varies from one to four. However, the distal cross vein is frequently so branched, especially in *estherae* and *dimidiata* that the cubito-anal space is a densely reticulated area and individual cross veins cannot be distinguished. Such branching was found in *estherae* (73 per cent of the wings examined), *dimidiata* (45 per cent), *intensa* (14 per cent), *obscura* (two per cent) and *pullata* (one per cent). There is a high degree of sexual dimorphism in this character in *estherae*, and differences of less degree between the two sexes of *dimidiata*. More or less branching of the distal cubito-anal vein was noted in 46 of the 47 male wings of *estherae* examined, but was evident in only three of the 20 female wings of this species examined. In *dimidiata*, however, branching of this vein occurred in five of the eight female wings examined, and in five of the 14 male wings seen. The usual number of cubito-anal cross veins in *Diastatops* is two, and the only considerable deviations from this number, in addition to the branching of the distal vein as noted above, occur in *intensa*, in which three veins were found in 31 per cent of the wings examined, and *dimidiata*, in which two veins were noted in only 18 per cent of the wings examined, three in 32 per cent and four in five per cent (vein branched in 45 per cent).

Needham and Broughton. M_1 , M_{1a} , M_2 , etc.—branches of the media. Mpl —median planate. patella—a reticulated area corresponding to the cell of this name as described by Needham and Broughton. poc—postnodal cross veins. pt—post-trigonal cells, the first row of cells following the triangle. R—radial series of postnodal cross veins. R_1 —radius. Rpl—radial planate. Rs—radial sector. Sc—subcostal series of antenodal cross veins. s-tc—supra-triangular cross veins. t—triangle.—2. Wings of *Diastatops intensa* showing the lines along which measurements were taken. a-b—length of wing. c-d—length of pterostigma. e-f—width of rear wing at base. g-h—width of rear wing at nodus.—3. Dorsal aspect of head of *Diastatops obscura*.—4. Base of rear wing of the type of *Diastatops fuliginea* Rambur (= *D. pullata*), showing extent of colored area (bounded by a broken line) and of the area of secondary reticulation (indicated by sinuous lines).—5. Base of rear wing of Rambur's example of *Diastatops pullata*, showing extent of colored and reticulated areas (as in figure 4).

The areas in which cells were counted are in the regions where secondary reticulation occurs in certain species and there are considerable differences between the several species and, in some cases, between the two sexes of the same species (see Table 1). Except in the "patella," the widest ranges and the largest numbers of cells are found in *estherae*.

The usual number of rows of cells subtended by Rpl or Mpl is two, except in *pullata* and *estherae*. In *pullata* there are almost always three rows (four rows subtended by Rpl in eight per cent of the fore wings and in 20 per cent of the rear wings examined; four rows subtended by Mpl in 29 per cent of the fore wings and three per cent of rear wings). In *estherae* two rows is the usual number subtended by Rpl (three rows in 12 per cent of the fore wings and 22 per cent of the rear wings; four rows in one per cent

TABLE 1. The number of cells in the triangles, in the first row following the triangle (pt) and in the "loop" of the fore wing, and in the patella of the rear wing.

Species	Number of cells (minimum, maximum and average)					
	Triangle		pt	"loop"	Patella	
	Fore wing	Rear wing			♂	♀
<i>pullata</i>	3- 8; 5.23	2- 8; 3.93	6-11; 7.73	6-14; 8.89	17- 66; 38.41	6-19; 13.19
<i>emilia</i>	3- 5; 4.11	3- 4; 3.33	5- 8; 6.44	4- 9; 6.66	21- 47; 33.25	9-12; 11.
<i>intensa</i>	3- 7; 4.19	3- 6; 3.5	5- 8; 6.33	5- 8; 6.77	54-141; 82.47	21-30; 25.5
<i>estherae</i>	5-23; 11.25	4-24; 10.82	7-15; 10.69	5-36; 14.61	17- 63; 39.83	12-27; 18.63
<i>obscura</i>	2- 9; 4.56	1- 7; 3.37	4- 8; 5.57	3-10; 6.11	3- 14; 8.55	3-15; 8.06
<i>nigra</i> ¹	4 ²	2- 3; 2.33	5- 7; 6.	6	7- 10; 8.17	
<i>maxima</i> ¹	4- 6 ³	2- 3	7	8	8- 10	
<i>dimidiata</i>	2- 8; 5.54	3- 7; 4.86	5- 8; 6.77	6-10; 7.86	2- 8; 4.27	3- 9; 4.86

¹ Female unknown.

² Where only one number is given, that number of cells was found in all wings examined.

³ As only two pairs of wings (one specimen) of this species were examined, averages are not listed.

in each wing), but a greater number is subtended by Mpl—in the fore wing three rows in 37 per cent, four in 53 per cent and five in 10 per cent of the wings examined; in the rear wing two rows in three per cent, three rows in 48 per cent, four in 42 per cent and five in seven per cent.

The maximum number of rows of cells between M_3 and M_4 is rather constant throughout the genus; two rows and three rows occur in more or less equal numbers in the wings examined in all species, except *estherae* in which three, four and five rows were found in approximately equal numbers in the rear wing and *dimidiata* in which two rows were found in all wings examined.

Secondary reticulation occurs in members of the *pullata*-group in the other areas in which rows of cells were counted (between the bisector of the loop and A_3 and between the outer branch of the bisector and Cu_2). In

species of the other groups the maximum number of rows in these areas is usually one or two, but in the males, especially, of the *pullata*-group the usual number is frequently three or four, and even five or more rows sometimes occur (see Table 2).

TABLE 2. Number of rows of cells between A_2 and A_3 and the number of cells between A_2 and Cu_2 , at the level of the forking of A_2 .

Species		Maximum number of rows of cells between A ₂ and A ₃									Number of cells between A ₂ and Cu ₂								
		Num- ber of wings exam- ined	Number of rows								Num- ber of wings exam- ined	Number of cells							
			1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	
pullata ¹	♂	120		1 ²	2	60	35	3			119		4	69	26	1			
	♀	58		67	33						58	10	88	2					
emilia	♂	14			36	64					14		57	36	7				
	♀	4		100							4		100						
intensa	♂	36				3	14	64	17	3	36		8	42	33	11	6		
	♀	2			100						2		100						
estherae	♂	47			9	53	30	9			47		23	9	49	15	2	2	
	♀	20		85	15						20	5	40	50	5				
obscura		180	2	98							180	14	84	2					
nigra		6	17	83							6	33	67						
maxima		2		100							2	100							
dimidiata		22		50	50						22	55	45						

¹ The areas are included within the region of secondary reticulation of the rear wing, the distinguishing characteristic of the *pullata*-group. As the density of the venation within the areas is much more pronounced in the male than in the female wing the tabulations of wings of males and of female of species of this group are given separately.

² The numbers in the table, except those in the columns designated as "Number of wings examined," are approximate percentages (nearest whole number) of the number of wings of the respective species examined.

RELATIONSHIPS WITHIN THE GENUS

The genus *Diastatops* is divided into three well-defined groups, consisting of four, three and one species, respectively. These groups are distinguished from each other by the density of the venation, the color of the veins and the pigmentation of the wing membrane.

In the *pullata*-group (*pullata*, *emilia*, *intensa* and *estherae*) certain areas in the wings are more densely veined (secondary reticulation or anastomosing of veins) than the remainder of the wings, and the veins within such

are red and usually somewhat thickened. These areas reach their maximum extent in *estherae*, and their maximum intensity in *intensa*. The veins in both the fore and the rear wings of the former species, from the base almost to the level of the nodus, except along the margins, are considerably more numerous than usual, somewhat thickened and bright red in color. The region of secondary reticulation is confined to a rather limited area in the basal portion of the rear wing in *intensa*. However, within this area the veins are exceedingly numerous and very much thickened, occupying as much or more of the total space as the cells which they enclose. These veins are brilliant scarlet in color. In *pullata* and *emilia* the area of secondary reticulation is confined to the basal region of the rear wing, is somewhat more extensive but much less intense than in *intensa*. In all four species these areas of secondary reticulation are more pronounced in the males than in the females. However, the corresponding areas in the females wings are, at least slightly, more densely veined than the remainder of the wings. In all the species of the *pullata*-group there is an area just distad of the nodus in which the membrane is more lightly pigmented than in other parts of the wings.

In the *obscura*-group (*obscura*, *nigra*, and *maxima*) there are no areas of secondary reticulation or thickened veins. However, the veins in the anal area of the rear wing of the (mature) females are usually red in color. The spot of light pigmentation distad of the nodus, although frequently present, is very faint and much reduced in area.

In *dimidiata*, the single species making up the third group, there are no areas of secondary reticulation, but sometimes the veins in the anal area of the rear wing of the female are red. In this species the pigmentation is absent from all of the distal half of the wings except a narrow marginal band. In the wings of the males and of some females a broad white band extends across the wings at the base of this otherwise hyaline area. The white band appears to have no counter-part in the species of the other two groups.

The other characters which distinguish the several species cut across these group lines.

Size, as expressed by the length of the wings and the abdomen, is of considerable value in separating species although there is more or less overlapping in almost all of the eight species. On the basis of size (approximate average length in millimeters of fore wing, of rear wing, and of abdomen, respectively, of the males) the species are arranged in the following order:

<i>maxima</i>	31	32	22	<i>emilia</i>	24	24.5	18
<i>pullata</i>	26.5	27	19.5	<i>intensa</i>	24	24	18
<i>nigra</i>	25.5	26	18	<i>obscura</i>	22	22	17
<i>estherae</i>	25	25.5	19	<i>dimidiata</i>	22	22	17

On the basis of the relative width of the wings (ratio of length to width of rear wing at the nodus) the species may be divided into four groups: 1.

obscura (2.33-2.51); 2. *dimidiata* (2.50-2.54) and *emilia* (2.52); 3. *intensa* (2.61-2.68), *estherae* (2.61-2.73), *nigra* (2.73) and *pullata* (2.74-2.77); and 4. *maxima* (2.84).

Two forms of the inferior appendage (of the male) are found in the genus; in one group of species the sides of the inferior are almost parallel or only slightly divergent, in the other the sides are widely divergent. The sub-parallel form is found in *estherae*, *nigra*, *maxima* and *dimidiata*, the divergent form in the other species. The inferior appears to be relatively shorter—only about one-half as long as the superiors—in *emilia*, *obscura* and *dimidiata* than in the other species, in which it is about two-thirds as long as the superiors.

The *pullata*- and *obscura*-groups are more closely related to each other than either is to *dimidiata*. Evidence of this relative isolation of *dimidiata* can be found in the undivided costal postnodal cells, the wide extent of unpigmented areas in the wings and the form of the median planate.

Within the *pullata*-group the two smaller species, *emilia* and *intensa*, are very closely related. The only clear distinction between them is found in the region of secondary reticulation (both area and extent) although there appears to be a slight difference in the relative length of the inferior appendage. *Pullata* and *estherae* exhibit a more or less close relationship and a common distinctness from *emilia* and *intensa* in such characters as large size, long wings, and range in the number of cross veins (or cells) in many areas. However, each of these exhibits distinctness in certain characters of which the other has the form found in *emilia* and *intensa*. In *estherae* the superior surface of the frons is red, that of the other species metallic purple; the sides of the inferior appendage are subparallel, those of the others widely divergent; areas of secondary reticulation are found in both wings, such areas in the other species are confined to the basal portion of the rear wing. In *pullata* the teeth of the superior appendage are not raised into a keel, but the superiors in *emilia*, *intensa* and *estherae* are distinctly keeled; the range in number of antenodal and postnodal cross veins is different (more numerous and with a greater spread) from those of the other three which are much alike.

The three species of the *obscura*-group differ little from each other in venational characters, but in size, relative width of wings, form of inferior appendage and location of teeth on the superiors *obscura* is quite distinct from the other two closely related species.

The primitive type of *Diastatops* was probably an intermediate form with regard to the characters now possessed by *dimidiata* and the species of the *obscura*-group. The wings were richly, but uniformly veined, with a large hyaline spot in the distal half of the wings and with red veins in the basal areas. The sides of the inferior appendage were sub-parallel and the superiors were keeled. The *dimidiata*- and *obscura*-groups have been developed by rather slight divergence in certain characters, the *pullata*-

group by a more divergent evolution from the primitive type, largely in the direction followed by the *obscura*-group, and the acquisition of certain new characters.

That the division of the costal postnodal cells by a longitudinal vein occurred in the *pullata-obscura* stem soon after the *dimidiata* stem had split off is indicated by the constancy of this character in all species of these groups. However, secondary anastomosing of cross veins progressed slowly before the separation of the *pullata* and *obscura* lines but had considerable subsequent development in the *pullata* line. The recency of the thickened and densely reticulated areas in the proximal portion of the wings is indicated by the variation, both among and within the four species which possess this feature.

RELATIONSHIPS WITH OTHER GENERA

The immediate generic relationships of Diastatops are rather clear. A single character, the separated eyes, is sufficient to set the species of the genus apart from all other Libellulidae and a second character, the undulate costal margin of the fore wing, unites them with the only closely related genera, Zenithoptera and Palpopleura. These three genera have many other, more or less distinctive, common characters (broad wings, intense venation, deep coloration, transverse carina of fourth abdominal segment, small and undifferentiated female genitalia, etc.) and have long been recognized as a distinct and somewhat isolated group. The very close relationship of Diastatops and Zenithoptera is shown by uniform and very dark coloration, form of body (head and thorax small; abdomen short, very slightly expanded near base and generally tapering slightly in remainder of length), form and position of the arculus, the number and high degree of variation in the antenodal cross veins, form of the bridge, bridge cross veins and cubito-anal cross veins, location and form of triangles and the occurrence of sectors dividing areas of the wings into transverse fields of two to four cells each. Certain characters of Palpopleura (light, although deep colors; larger head and thorax; broad and somewhat depressed abdomen; slightly more distal location of the arculus; smaller number of antenodals; variation in cubito-anal and bridge cross veins) indicate relationships with other groups and this genus may well be considered as intermediate in position between the Diastatops-Zenithoptera complex and the main stem of Libellulid evolution.

Ris (1910) united Perithemis with the old Gruppe III of Brauer on the basis of primitive trends in the venation, especially the form of M_2 , Rs and $Rspl$. This group (III of Ris, Palpopleurini of Tillyard) thus constituted possesses a combination of rather distinctive features and can be easily characterized, as in the following description.

Wings relatively broad and deeply colored. Arculus between first and second antenodals, often very near the first. Sectors of the arculus separated in the fore wing, with a short common stem in

the rear wing. Bridge cross veins usually present. Last antenodal of fore wing incomplete. Anal area of rear wing very broad; bisector of the loop nearly straight; cells between loop and anal margin frequently arranged in transverse rows. Lobe of prothorax large. Legs rather long and slender; tarsal claws usually short, tooth small and near apex.

However, Perithemis possesses several characters in common with the genera of the Leucorrhiniini (Gruppe VII of Ris)—form of head, triangle and postrigonal field of fore wing—and could easily be placed in that group.

Needham and Broughton (1927) further expanded the group by the addition of 16 other genera. The group thus formed (Celithemini of Needham and Broughton) contained genera scattered almost throughout the entire system erected by Ris. In addition to Gruppe III, one genus from IV (Thermochoria), seven from VI (Neurothemis, Philonomon, Brachythemis, Deielia, Crocothemis, Bradinopyga and Pseudoleon), two from VII (Planiplax and Celithemis) and six from X (Selysiothemis, Ephidatia, Aethriamanta, Macrodiplax, Urothemis and Rhyothemis) were included. However, this arrangement has little to support it and appears to have been based largely if not entirely, upon data tabulated from the photographs of wings in Ris' Libellulinen—limited for the most part to one pair of wings of the type species of each genus.

The leg characters of these genera present no evidence of any close relationship to Diastatops (see "Leg Characters of Related Genera," pages 259-278). The author is inclined to restrict the Palpopleurini to the three genera with undulate costal margin of the fore wings and to place Perithemis with the Leucorrhiniini. These two lines (Palpopleurini and Leucorrhiniini) probably split from the general Libellulid stem at or near the same point. The apparent relationship of Palpopleura and Perithemis is due to their parallel development following an early separation in each case from the tribal line of evolution. The separation of Diastatops and Zenithoptera has been comparatively recent and the formation of species within each is in an early stage.

The Species of Diastatops

KEY TO SPECIES

1. Wings more or less colored throughout; three to seven cells following the first in the costal postnodal area bisected by a longitudinal vein, or with anastomosing cross veins in this area 2
- 1'. Base of wings to level of nodus dark brown or black, followed by a broad white band in mature specimens; remainder of wings transparent or almost so, except the costal area and tip in both wings and a band two to four cells wide along caudal margin of rear wing which are brown; costal postnodal cells not crossed. *dimidiata* Linn.
- 2(1). No secondary anastomosing of veins; veins usually uniformly black or brown throughout wings (sometimes red in anal area of rear wing in *obscura*); light spot beyond nodus very indistinct and limited to area near costal margin, if present. 3
- 2'. Veins in anal area of rear wing, or in more extensive areas, more numerous ("secondary anastomosing" or "secondary reticulation") than in remainder of wings, usually red or yellow and somewhat thickened; usually with a distinct light spot or band, frequently extending half or two-thirds of the width of the wing, just beyond nodus. 5

- 3(2). Wings relatively long and narrow, 25 mm., or more long, ratio of length to width at nodus about 2.75 to 1; abdomen 18 mm., or more long; teeth on ventral margin of superior appendages not reaching the level of the tip of the inferior appendage, more caudal teeth most elevated; sides of inferior sub-parallel. 4
- 3'. Wings relatively short and broad, usually less than 25 mm., long, ratio of length to width at nodus about 2.30 to 1; abdomen usually less than 18 mm., long; teeth of superior appendages reaching to or beyond the level of the tip of the inferior appendage, median teeth most elevated; sides of inferior divergent. *obscura* Fabr.
- 4(3). Wings about 25 mm., long; abdomen about 18 mm., long. *nigra* n. sp.
- 4'. Wings about 30 mm., long; abdomen about 22 mm., long. *maxima* n. sp.
- 5(2'). No area of dense venation (secondary reticulation) and no red veins in fore wing; triangle of fore wing usually containing three to eight cells, that of rear wing three to six cells; superior surface of frons brown or metallic purple. 6
- 5'. Areas before and after the triangle in the fore wing with secondary reticulation, veins in these areas red; triangle of fore wing containing five to 20 or more cells, that of rear wing four to 20 or more cells; superior surface of frons red. *estherae* n. sp.
- 6(5). Wings usually less than 25 mm. long; usually less than 18 costal antenodal cross veins in fore wing and less than 12 in rear wing; two rows of cells subtended by Rpl and Mpl; superior appendages distinctly keeled below. 7
- 6'. Wings 25 mm. or more long; usually 18 or more costal antenodal cross veins in fore wing and 12 or more in rear wing; three or four rows of cells subtended by Rpl and by Mpl; teeth on ventral margin of superior appendages not elevated into a keel. *pullata* Burm.
- 7(6). Area of secondary reticulation in anal area of rear wing rather extensive, extending caudad in loop about two-thirds of distance from forking of bisector to tip of loop; veins of this area dull red, not especially thickened; three to four rows of cells between A_3 and the bisector opposite fork of latter (one to two rows in female); usually not more than two cells between A_1 and outer branch of bisector at its origin; secondary loop (patella), if formed, containing 35-50 cells (nine to 12 in female). *emilia* n. sp.
- 7'. Area of secondary reticulation in rear wing very dense but more limited in extent, extending caudad in loop less than half of distance from forking of bisector to tip of loop; veins in this area carmine (brilliant yellow in teneral specimens), much thickened, frequently as broad as cells enclosed (less dense in female); usually five to seven rows of cells between A_3 and the bisector (three rows in female) and three to six cells between A_1 and outer branch of bisector (only two in female); secondary loop, if formed, containing very many cells (usually 65-140, infrequently less than 60; 21-30 in female). *intensa* n. sp.

DIATATOPS PULLATA (Burmeister)

Libellula pullata Burmeister, 1839, Handb. Ent., 2: 854.

Diatatops pullata Rambur, 1842, Ins. Nev.: 135; Hagen, 1861, Syn. Neur. N. Am.: 321; Brauer, 1868, Verh. Zool. Bot. Wien, 18: 716; Hagen, 1875, Proc. Bost. Soc., 18: 96; Kirby, 1889, Tr. Zool. Soc. Lond., 12: 272; 1890, Cat. Od.: 8; 1897 Ann. Mag. Nat. Hist., (6), 19: 602; Calvert, 1898, Tr. Am. Ent. Soc., 25: 71, 94; Schmidt, 1915, Zool. Jahrb. Anat., 39: 7; Ris, 1916, Coll. de Selys, 16: (2): 1109, 1110, 1112 (in part).

Diatatops obscura, form *pullata*, Ris, 1910, Coll. de Selys, 11: 309-311 (in part).

Diatatops fuliginea Rambur, 1842, Ins. Nev.: 137; Erichson, 1848, Schomburgks Reisen, 3: 584; Kirby, 1890, Cat. Od.: 8; Calvert, 1909, Ann. Carn. Mus., 6: 260 (in part); Ris, 1910-1916, Coll. de Selys, 11: 309-310; 16: (2): 1110.

Recorded distribution: America (Rambur, 1842): S. America (Kirby, 1890). BRITISH GUIANA: Georgetown, Tumatumari, and Wismar (Ris, 1916). SURINAM: Burmeister, 1839; Ris, 1910. FRENCH GUIANA: Cayenne (Ris, 1910). BRAZIL: Pará: (Ris, 1910); Parana de Buyassu (Kirby, 1897); Villanova, Santarem, and Obidos (Ris, 1910); Amazonas: Manáos (Kirby, 1897); Matto Grosso: (Ris, 1916); Pernambuco: (Hagen 1861, 1875, Brauer, 1868). PERU: Moxos (Hagen, 1861, 1875; Brauer, 1868); Pebas? ("Peba," Ris, 1910).

Material studied: BRITISH GUIANA: Georgetown, October 10-15, 1920, 1♂ (W. T. M. Forbes; Cornell Univ.); January 25 and 26, 1912, 3♂ 1♀ (B. J. Rainey and L. A. and E. B. Williamson; Mich. Mus. Zool.); Wismar, February 15 and 16, 1912, 5♂ (Rainey and Williamsons; Mich. Mus.

Zool.); Tumatumari, February 11, 1912, 1♂ (Rainey and Williamsons; Mich. Mus. Zool.). SURINAM: 1♂ (I. R. Martin; Coll. Ris); ? 1♂ (bought from Staudinger and Bang-Haus, labelled, "... 3 Sur 10"; Mich. Mus. Zool.). FRENCH GUIANA: Pied Saut, Oyapok River, November, 1917, 2♂ and December, 1917, 1♂ (S. M. Klages; Carn. Mus.). BRAZIL: Pará: Uassa Swamp, Oucoupe Island, June, 1918, 1♂ 1♀ and Uassa Island, June, 1918, 1♀ (S. M. Klages; Carn. Mus.); Parana de Buyassu, January 15, 1896, 1♀ (E. E. Austen; Br. Mus.); Bota Io Pinto, November 6, 1901, 2♂ (Hagman; Coll. Ris); Rio Xingú, Alta Mira, January, 1921, 1♂ 1♀ and Victoria, May 1921, 1♀ (A. H. Fassl; Coll. Ris.); Rio Tapajóz: Itaituba, February, 1922, 1♂, Mte. Christo, June, 1920, 3♂ 2♀, Barreiras, May, 1920, 2♂ 3♀, June 25, 1920, 2♀ (A. H. Fassl; Coll. Ris); Santarem, February, 1920, 1♂ 2♀, February, 1921, 1♂, March, 1922, 1♀, July, 1920, 1♂ January 6, 1922, 1♂, and Taperinha, near Santarem, June, 1920, 2♂ 1♀ (A. H. Fassl; Coll. Ris); Amaz[on], 1♂ (Br. Mus.); Amazonas: East Amazonas, 1♂ (Am. Mus. Nat. Hist.); Maués, April, 1921, 1♂ (A. H. Fassl; Coll. Ris.); Progresso, January 11, 1922, 1♂ (J. H. Williamson and J. W. Strohm; Mich. Mus. Zool.); Manáos, July, 1921, 3♂ 2♀, June, 1922, 1♂ (A. H. Fassl; Coll. Ris); Moura, Rio Negro, July 11, 1922, 2♂ 2♀ (J. H. Williamson and J. W. Strohm; Mich. Mus. Zool.); Manacapuru, August, 1921, 3♂ (A. H. Fassl; Coll. Ris); Coury, July 1, 1920, 1♂ (H. S. Parish; Mich. Mus. Zool.), July, 1922, 1♀ (A. H. Fassl; Coll. Ris); Tefé Ega, August 1921, 2♂, and July, 1922, 3♀ (A. H. Fassl; Coll. Ris); Sao Paulo de Olivenca, Alto Rio Solinoes, May, 1932, 1♂ (bought from F. Wucherpfennig; Mich. Mus. Zool.); Nova Olinda, Rio Purús, June, 1922, 2♂ 1♀ (S. M. Klages, Carn. Mus.); Porto Velho, Rio Madeira, January 24 and 29, February 9 and 10, 1922, 6♂ (J. H. Williamson and J. W. Strohm; Mich. Mus. Zool.); Matto Grosso: 1♂ 1♀ (bought from Zobrys, 1911; Coll. Ris); Bahia: Boqueirao, January 7, 1908, 1♂ (J. D. Haseman; Carn. Mus.). PERU: Iquitos, August 5, 1920, 1♂ (W. T. M. Forbes; Cornell Univ.).

Original description.—34. *L. pullata**: fusca, alis concoloribus, posticarum macula baseos abdomineque ferrugineis. Long. 1" 1"! Aus Surinam; in Sommer's Sammlung.

Original description (of fuliginea).—*Rufa: alis fuligineis; posticis ad basim rufescentibus, nervis praecipuis elevatis* ♂.

Fabr., *Ent. syst.*, II, p. 377, no 15. *L. Obscura*?—Burm., *Handb. der Ent.*, II, pag. 854, n° 35. (*L'Obscura* de Fabricius paraît plutôt se rapporter à la *Fulvia* de Drury.)

A peu près de la taille de la *Pullata*, à laquelle elle ressemble beaucoup et dont elle n'est peut-être qu'une variété. Corps semblable; pièce sous-styloire plus étroite, à peine rétrécie à la base, sur laquelle les côtés tombent presque carrément, ayant le fond de l'échancrure non arrondi, mais formant un angle rentrant. Ailes d'une teinte plus pâle, avec un léger reflet violet des deux côtés, un peu rougeâtres à la base des postérieures où les aréoles sont plus nombreuses que chez la *Tincta*, mais un peu moins que chez la *Pullata*.

A large, rather dark species.

Male. Thorax black above. Wings long; dark from base to nodus, especially along costal margin; a conspicuous light area, extending backward from the costal margin in a triangle or arc about one-half to two-thirds of the width of the wing, just beyond nodus; remainder of wing moderately dark. Reticulated area in rear wing extending to level of the outer angle of loop, separated from caudal margin by about four or five cells; veins within this area thickened and anastomosing. Veins within reticulated area and those bordering this area red; those in corresponding area in fore wing reddish brown; veins in remainder of wings black. Cephalic surface of anterior lamina smooth; caudal margin sinuate, with a deep, wide, V-shaped emargination in center. Superior appendages about as long as segments 9 and 10, teeth not elevated on a distinct keel; inferior about two-thirds as long as superiors, sides widely divergent.

Female: Similar to male; venation less dense in reticulated area. Appendages about two-thirds as long as segment 9.

Venational indices:¹ anc:² f.w.—C 17-25 (20.41), Sc 15-22 (18.49); r.w.—C 11-17 (13.74), Sc 11-16 (13.06). poc: f.w.—R 11-19 (14.27); r.w.—C 12-19 (15.78), R 11-18 (14.78). bc: f.w.—3-9 (6.28); r.w.—3-12 (6.83). s-tc: f.w.—4-11 (7.73); r.w.—0-4 (2.14). Cells: t: f.w.—3-8 (5.23); r.w.—2-8 (3.93). pt: 6-11 (7.73). "loop": 6-14 (8.89). patella: ♂—17-66 (38.41); ♀—6-19 (13.19).

Measurements: ♂: abdomen—17-21 mm.; femora, second—>4 mm., third—>5 mm.; tibiae, second—<5 mm., third—7 mm.; fore wing—24-28.5 mm., pterostigma—4 mm.; rear wing—25-29 mm., pterostigma—>4 mm., width, base—10.5-12 mm., nodus—9-10.25 mm. (ratio:³ base—2.33-2.45, nodus—2.74-2.77). ♀: abdomen—16-20 mm.; femora, second—4 mm., third—>5 mm.; tibiae, second—<5 mm., third—>7 mm.; fore wing—24-28 mm., pterostigma—<4 mm.; rear wing—24-28.5 mm., pterostigma—4 mm., width, base—10.5-11.5 mm., nodus—9.5-10.5 mm. (ratio: base—2.29-2.48, nodus—2.53-2.71).

Type: ♂, "Aus Surinam; in Sommer's Sammlung" (now in Naturhistorisches Museum in Vienna).

The specific names (*pullatus*, clad in black garments—of mourners; *fuligo* (gen. *fuliginis*), soot) selected by Burmeister and Rambur for this species are very appropriate for the rather dark and somber insect depicted by specimens of this species. However, the appearance presented in its native habitat as it darts into the sunlight from a shaded creek or river bank, with flashing iridescent wings and brilliant scarlet abdomen would seem to be most unlike a mourner!

In length of wings and abdomen, form of superior appendages (teeth not elevated on a keel), and in many venational characters *pullata* exhibits more or less close relationship to *estherae*, but in the more limited area of dense venation, coloration of frons and shape of the inferior appendage it approaches *emilia* and *intensa*. In spite of some overlapping in the range of variation found in the specimens studied, *pullata* is distinctly a larger insect than *emilia* or *intensa*. The number of antenodal and postnodal cross veins and the number of rows of cells between Rs and Rpl, especially in the fore wing, are greater than in any other species of the genus. Dr. H. Zerny (in litt., Sept. 14, 1932; freely translated here) furnished information from Burmeister's type on three specified characters:

1. Color of frons—"dark metallic blue, on vertical surface yellow-brown."

2. Extent of red or reddish areas in wings—"border of red spots of

¹ The exact location of these cross veins and cells is indicated in Pl. I, fig. 1, p. 230.

² A key to these abbreviations is included in the explanation accompanying Figure 1, plate I.

³ These ratios are ratios of the length of the rear wing to its width at base and nodus, respectively, along the lines indicated in Figure 2, plate I. The two figures for each ratio represent the shortest and longest (in proportion to width) wings, for which ratios were calculated of the particular sex and species.

rear wings include t, Cu, M₄, 2 or 3 cells distal from t, 2 or 3 cells distal from forking of Cu₂; at the anal loop the edge of the red spot is four cells distant from the wing margin, then it approaches the latter toward the anal angle and reaches it at the root of the wing."

3. Extent of thickened, or condensed, venation—"identical with 2, not especially dense."

Miss Heiss made the following notes from the Ramburian specimens in the de Selys Collection.

"Rambur's type of *D. fuliginea*—Specimen broken, but has one complete front wing and one damaged complete hind wing on left, very small portion of base of front wing and about $\frac{1}{2}$ of the hind wing on right. Entire abdomen missing—there were two abdomens in a triangle in the corner of the box but there were also four other specimens with whole or part of abd. missing so I did not think it worthwhile to make drawings of the pieces. Color of frons—brown; same color as wings exactly. Wing counts; a. Maximum number of cell rows enclosed by Mpl, front wing—3, hind wing—4; b. Approximate no. of cell rows between bisector and A₃—4 to 5, covered by sec. ret. in center; c. No. of cells in triangle, front wing—5 on left and four on right, hind wing—4. No secondary reticulation at all on front wing. Areas of coloration (in rear wing) dim but can be distinguished on microscope as faintly coral colored. Secondary ret. most closely resembles photo # 4 (*pullata*); it seems to be identical.

"(Probably) Rambur's example of *D. pullata*—Frons—light brown. Genitalia of segment 2 too badly gummed up to see at all. Wing counts: a. Max. no. of cell rows enclosed by Mpl, on front wing—4, hind wing—3; b. Approximate no. cell rows between bisector and A₃—5 and 6, or 4 and 5; covered by sec. ret.; c. No. of cells in triangle, front wing—4 on l., 6 on right, hind wing—4. Secondary reticulation about as dense as # 4 (*pullata*) but slightly more extensive in area."

All of the female and many of the male specimens of this species available for study are more or less teneral.

J. H. Williamson made the following notes on the coloration of a fresh specimen, a male collected at Porto Velho, January 24, 1922. "Eyes uniform, dull dark brown. Face—same dull dark brown. Lower lip a dull greenish gray. Thorax—very dark on top with a purple cast, changing to dull brown on sides and below. Legs—dark with slight purple cast. Abdomen—1, black on top; 2-8, a dull red on top; 9, red anteriorly and black posteriorly; 10, black; on ventral surface—2, same dull brown as sides of thorax; 3, changing to lighter brown; and the rest lighter brown. Upper appendages black." The specimen has retained most of this coloration. The labium has lost the greenish tint and is now yellowish brown. The labrum and anterior surface of frons have an orange or reddish cast, but the clypeus is brown (olive or greenish brown) and, especially when viewed by

the unaided eye, is very nearly the same color as the eyes. The legs are distinctly *not* "dark with slight purple cast," except possibly the anterior pair and all feet; the second and third pairs of legs are rather light and the tibiae are distinctly reddish. The abdomen is largely red; the dorsum of segment 1 and the anterior half of 2, black; sides of 2 and 3 changing from the olive brown of the sides of the thorax to the light reddish brown of the under side of segments 4-10; segment 9 not black except dorsal and caudal carinae and segment 10 with an anterior reddish spot on either side.

Ris (1910) quotes two brief notes by Bates concerning the habits of this species, "banks of pools in valley near Obydos, 13. I. 49," and "woods Santarem, settling on twigs on the shade of trees." Somewhat more extensive notes (parts of which were quoted by Ris, 1916) accompany some of the specimens collected by the Williamson expeditions. "Both species occur together in brush about pools in the Botanical Gardens at Georgetown, but *pullata* is much the more brilliant and active species. Contrary to what one might expect in such brilliant insects they are brush-loving, especially *pullata*, which never occurs anywhere else, and always takes to brush to escape, except in the case of *obscura*, when it is found away from brush, which is often the case." "This and related species (*obscura*) captured January 25, 1912, frequented dense brush near canals in Bot. Gardens. Very difficult to capture because of dense growth. Had a habit of low flight and walked on twigs—sometimes several inches—a most peculiar species in actions." "Seemed to stay in toward trunk of small trees on bank or over flooded creek bed and dart out to sun-exposed twigs or even onto leaves. Sometimes walked out several inches toward end of twig after alighting thereon. Not common to date at any place seen."—(Porto Velho, February 10, 1922). "Caught from the river steamer when we stopped to cut grass 6' high along the bank of the parana at 8 a.m." at Progresso, January 11, 1922. "Collected at swampy creek. . . . between 8:30 and 10 a.m. Little sunshine and at 10 heavy rain started," Porto Velho, January 24, 1922. "Taken at flooded creeks entered by launch from River Madeira, all within 5 or 6 miles below town (Porto Velho)," January 29, 1922.

***Diastatops emilia* n. sp.**

Material studied: BRAZIL: *Pará*: Rio Tapajóz: Barreiras, May, 1920, 1♂; Mte. Christo, June, 1920, 2♂ 1♀, Miratituba, April, 1921, 4♂ 1♀ (A. H. Fassl; Coll. Ris).

A small, moderately dark species.

Male: Wings rather broad; dark, especially in basal half and along costa. Reticulated area very similar in extent to *pullata* but somewhat more dense; veins in this area and those cephalad of it to the level of the arculus red. Veins in vicinity of arculus of fore wing slightly reddish brown at most, usually black. Cephalic surface of anterior lamina with a few denticles; caudal margin sinuate, with a broad arc-shaped emargination in

center. Superior appendages about equal in length to segments 9 and 10, teeth elevated on a keel; inferior slightly more than one-half as long as superiors, sides widely divergent.

Female: Similar to male, except that the reticulated area of the male is indicated only by red, very slightly thickened veins.

Venational indices: anc: f.w.—C 15-18 (15.84), Sc 14-16 (14.66); r.w.—C 10-12 (10.83), Sc 9-11 (10.33). poc: f.w.—R 8-12 (10.28); r.w.—C 11-15 (12.55), R 8-11 (10.44). bc: f.w.—2-4 (3.11); r.w.—2-5 (3.72). s-tc: f.w.—3-7 (4.55); r.w.—1-2 (1.16). Cells: t: f.w.—3-5 (4.11); r.w.—3-4 (3.33). pt: 5-8 (6.44). "loop": 4-9 (6.66). patella: ♂—21-47 (33.25); ♀—9-12 (11).

Measurements; ♂: abdomen—17-19 mm.; femora, second—<4 mm., third—5 mm., tibiae, second—4.5 mm., third—6.5 mm.; fore wing—23-25 mm., pterostigma—3 mm.; rear wing—23-26 mm., pterostigma—3.5 mm., width, base—10.5-10.75 mm., nodus—9.5 mm. (ratio: base—2.23-2.38, nodus—2.52). ♀: abdomen—16.5-17 mm.; femora, second—<4 mm., third—5 mm.; tibiae, second—5 mm., third—<7 mm.; fore wing—23 mm., pterostigma—3 mm., rear wing—23 mm., pterostigma—3.5 mm., width, base—10.75 mm., nodus—9.75 mm. (ratio: base—2.14, nodus—2.36).

Types: Holotype ♂ and allotype ♀—Miritituba, April, 1920 (Coll. Ris); paratypes—all other specimens studied.

This species is named for my young daughter, Emily Joan Montgomery.

This species is very close to *intensa*, differing only in the extent and degree of intensity of the secondary reticulation and coloration in the anal area of the rear wing. This is more extensive, but less intense in *emilia*, which approaches *pullata* in this character. The difference in degree of intensity of the venation of the two species is well illustrated in the tabulations of the number of rows of cells between the bisector of the loop and A_3 and the number of cells in the first row between the outer branch of the bisector of the loop and Cu_2 .

In the female from Mte. Christo, which is slightly teneral, the veins to the level of the nodus in both wings are reddish brown.

Diastatops intensa n. sp.

Diastatops pullata Calvert, 1909, Ann. Carn. Mus., 6: 260; Ris, 1916, Coll. de Selys, 16: (2): 1110 (in part); Longfield, 1929, Tr. Ent. Soc. Lond., 77: 127 (in part?).

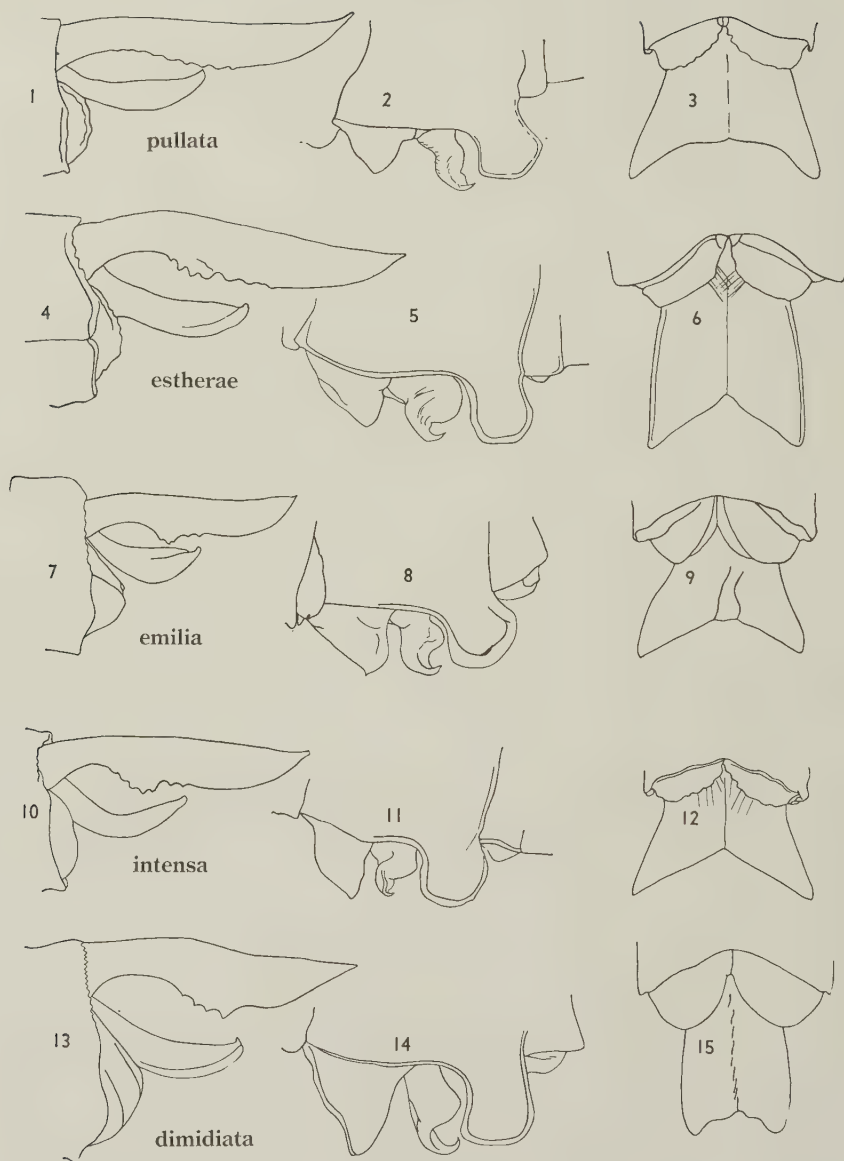
Diastatops pullata (forma) Ris, 1928, Konowia, 7: 45.

Diastatops obscura form (or var.) *pullata*, Ris, 1910, Coll. de Selys, 11: 311 (in part); Navas, 1921, Estudios, 1921: 49; 1923, Arx. Inst. Cien., 7: 179.

Recorded distribution: BRAZIL: *Pará*, Rio Amazonas (Ris, 1928); *Matto Grosso*; Cachoeira and Cachoeira Cuyaba Lagoa (Calvert, 1909); R. Paraguay, Rio Sao Lourenco and Rio Cuyaba (Longfield, 1929); *Rio de Janeiro* (Ris, 1910); *Rio Grande do Sul* (Ris, 1910). PARAGUAY: (Ris, 1910). ARGENTINA: Lapango and Formosa (Ris, 1928); Santa Fé (Navas, 1921); Corrientes (Navas, 1923).

Material studied: BRAZIL: *Pará*: Santarem, July, 1920, 4♂ and Taperinha, near Santarem February, 1920, 1♂, April, 1920, 1♂, June, 1920; 1♂, July, 1920, 2♂ (A. H. Fassl; Coll. Ris);

PLATE II



Lateral views of appendages and genitalia and ventral view of inferior appendages of males of species of *Diastatops*.—1-3. *D. pullata*, Wismar, British Guiana, February, 1912.—4-6. *D. estherae*, type, Manáos, Brazil, June 10, 1922.—7-9. *D. emilia*, paratype, Mte. Christo, Rio Tapajóz, Brazil, June, 1920.—10-12. *D. intensa*, paratype, Santarem, Brazil, July, 1920.—13-15. *D. dimidiata*, Cano d'Vagre, Venezuela, January 28, 1911.

Amaz(on), 1 ♂ (Br. Mus.); *Matto Grosso*: Cachoeira, 1 ♂, and Cachoeira Cuyaba Lagoa, January 29, 1 ♂ (H. H. Smith; Carn. Mus.); Rio Paraguay: Rio Sao Lourence, May 4, 1937, 1 ♂, and Rio Cuyaba, May 6, 1927, 1 ♀ (Cynthia Longfield; Br. Mus.); *Rio Grande do Sul*: 2 ♂ 1 ♀ (H. von Ihering; Acad. Nat. Sci. Phil.). PARAGUAY: 2 ♂ (E. Weiske, ex Mus. München; Coll. Ris). ARGENTINA: Formosa, December 4, 1917, 1 ♂ (Jorgensen; Coll. Ris).

A rather dark species.

Male: Wings rather long; dark, postnodal light areas frequently absent. Second cubito-anal cross vein running to inner angle of triangle or more proximad. Reticulated spot in rear wing very dense, but rather limited in area, not extending into triangle or cubital cell and separated from anal margin of wing by six to eight cells; veins within this area much thickened, heavily anastomosed—veins occupying almost as much space as membrane—and deep scarlet in color. (In tenerals these veins are bright yellow.) Remainder of veins black, except those in triangle and a few others immediately adjacent to reticulated area which are red. Cephalic surface of anterior lamina bearing a few fine spines or denticles; caudal margin sinuate with a wide, shallow, arc-like emargination in center. Superior appendages about equal in length to segment 9, teeth elevated on a keel; inferior about two-thirds as long as superiors, sides widely divergent.

Female (somewhat immature): Postnodal light spots very prominent, without dense reticulated area of male, but veins in this area, and also those in the postnodal light areas and in center of fore wing from base to five or six cells beyond triangle light in color (cream yellow in dried specimen).

Venational indices: anc: f.w.—C 13-18 (14.94), Sc 13-18 (14.88); r.w.—C 10-12 (10.8), Sc 9-12 (10.66). poc: f.w.—R 7-12 (9.19); r.w.—C 9-14 (10.52), R 7-13 (9.66). bc: f.w.—1-4 (2.41); r.w.—2-6 (3.31). s-tc: f.w.—3-9 (5.83); r.w.—0-3 (1.44). Cells: t: f.w.—3-7 (4.19); r.w.—3-6 (3.5). pt: 5-8 (6.33). "loop": 5-8 (6.77). patella: ♂—54-141 (82.47); ♀—21-30 (25.5).

Measurements: ♂: abdomen—17-19.5 mm.; femora, second—4 mm., third—5 mm.; tibiae, second—<5 mm., third—6.5 mm.; fore wing—21.5-25.5 mm., pterostigma—3 mm.; rear wing—21.5-25.5 mm., pterostigma—3.5 mm., width, base—9-11 mm., nodus—8.25-9.5 mm. (ratio: base—2.32-2.39, nodus—2.61-2.68). ♀: abdomen—16 mm.; femora, second—3.5 mm., third—4.5 mm.; tibiae, second—4 mm., third—5.5 mm.; fore wing—24 mm., pterostigma—3 mm.; rear wing—24 mm., pterostigma—3.75 mm., width, base—11 mm., nodus—10 mm. (ratio: base—2.18, nodus—2.40).

Types: Holotype ♂—Taperinha, July, 1920 (Coll. Ris); allotype ♀—Rio Cuyaba, May 6, 1927 (Br. Mus.); paratypes: all other specimens studied, except the female from Rio Grande do Sul.

Intensa (from *intense*, extreme in degree, excessive) was chosen as the

name for this species because of the great intensification of the venation in the anal area of the rear wing.

This species is very close to *emilia*, being distinguished from that species, in so far as I have been able to ascertain, only by the much greater density, more intense coloration, and more limited area of the secondary reticulation of the rear wing.

At first I was somewhat inclined to make this form a variety of *emilia*. However, my personal aversion to trinomials and the fact that specimens of *intensa* from such widely separated localities as Santarem, Matto Grosso, Rio Grande do Sul and Argentina show very little variation in the density of the reticulated area (such variation as does occur being in specimens from localities far removed from the region in which *emilia* was found) led me to accord the two forms specific distinctness.

The female from Rio Grande do Sul is rather doubtfully placed in this species. It is very teneral; the head and body are flattened and twisted and have the undifferentiated light brown color of dried tenerals, and the wings are very light in color—semi-transparent. Except for a slight thickening and secondary anastomosing of veins in a limited area caudo-distad of the triangle it agrees very well with *obscura*. In the number of cells in the secondary loop (11-13), the number of rows of cells between the bisector and A_3 (2 in both wings), and the ratio of length to width of rear wing at the nodus it differs, slightly, at least, from the allotype female of *intensa* and is quite characteristic of *obscura*. In such other characters as can be determined from such an immature specimen (chiefly venational) it falls within limits common to the two species.

Of the two males from Rio Grande do Sul, one, although very teneral, appears to be typical of this species, but the other (almost mature) differs from all other specimens of the species in having the red color of the veins in the spot at the base of the rear wing less bright and somewhat more extensive in area. However, the number and thickness of the veins in this area are approximately the same as in other specimens and the lighter color appears to be due to fading of an original bright red.

The abdomen is missing from the allotype female; broken bits of an abdomen were present in the shipping box when it was received from London, but the abdomen of a female *pullata* in the box was also missing and there was nothing to indicate to which, if not to both, the fragments belonged; furthermore they were too broken up to be of any value.

Because of the unsatisfactory condition of the female of this species available to me for study I am quoting certain notes from Ris (1910, 1916, 1928), referring to material not available to me.

Paraguay (coll. Selys), *Prov. Rio Janeiro* (Hamburg) and *Rio Grande do Sul* (coll. Selys). Die Exemplare sind unter sich ziemlich gleich, eine Form, die in der Ausdehnung der Verdichtung und des Basisflecks ziemlich mit den surinamischen und Santarem-Exemplaren übereinstimmt (σ bis auf das Niveau der Aussenecke der Schleife, die äusserste Spitze der Schleife und ca. 5-6 Zell-

breiten am Analrand freilassend; ♀ in etwa gleichem Umfang helle Adern aber geringe oder gar keine Verdichtung), aber kleiner, vor allem kurzflüglicher ist. ♂ Abd. 19, Hfl. 25, Pt. 3 (Paraguay); Abd. 19, Hfl. 26, Pt. 3.5 (Prov. Rio); Abd. 17, Hfl. 24, Pt. 3.5 (Rio Grande do Sul).—♀ Abd. 16, Hfl. 23, Pt. 3 (Paraguay); Abd. 16, Hfl. 24, Pt. 3.5 (Rio Grande do Sul).

Bei den ♂ von Paraguay ist der Fleck kleiner, bleibt vom Analrand fast 3 mm entfernt; die Aderverdichtung ist in seinen centralen Teilen eine ganz extreme, die Färbung (subjuv.) noch gelb, teilweise gelbrot. Die Proportionen zeigen eine gewisse Annäherung an *obscura*: Abd. 17, Hfl. 24.5: 10.3, Pt. > 3.

Etwas immatur, doch Abd. schon rot.—Linker Vfl. unvollständig entwickelt. Rechter Vfl. und beide Hfl. mit der für *pullata* ♀ charakteristischen diffusen teilweisen Aufhellung in postnodaler Bogenbinde; auch die Spitze der Vfl. (auch des missbildeten linken) vom Pterostigma an sehr diffus etwas gelichtet.—Aderverdichtung im Hfl. in Form eines Langstreifs, hellgelb: Schleife bis zur Gabel von A₂, Cu₁–Cu₂ und Discoidalfeld in gleicher Breite, allmählich auslaufend bis fast zum Niveau des Nodus; stärkste Verdichtung in der Schleife, Cu₁–Cu₂ und Beginn des Discoidalfeldes; immerhin keine extreme Verdichtung, im Discoidalfeld 4–5 Zellreihen. Keine Verdichtung im t. Keine Verdichtung im Vfl. Stirn schwarz.

The references by Navas have been placed under this species because it is the only one of the *pullata*-group, for which there are verified records more than 5° or 10° south of the equator.

Diastatops estherae n. sp.

Diastatops pullata Kirby, 1897, Ann. Mag. Nat. Hist., (6), 19: 602 (in part).

Recorded distribution: BRAZIL: Amazonas, Manáos (Kirby, 1897).

Material studied: Southern BRITISH GUIANA: 1 ♂ (Acad. Nat. Sci. Phil.). BRAZIL: Amazonas, East Amazonas, 1 ♂ (A. Mus. Nat. Hist.); Maués, Rio Maués, April, 1932, 1 ♂, May, 1932, 1 ♀ (Bought from F. Wucherpfennig; Mich. Mus. Zool.); Manáos, February 11, 1896, 1 ♂ (E. E. Austen; Br. Mus.), February, 1908, 2 ♂ (Miss M. B. Merrill; Acad. Nat. Sci. Phil.), June 7, 1922, 4 ♂, and June 10, 1922, 2 ♂ (J. H. Williamson and J. W. Strohm, Mich. Mus. Zool.); Tonantins, September, 1923, 12 ♂ 9 ♀ (S. Klages, Carn. Mus.).

A very bright colored species.

Male: Labrum and face, including superior surface of frons, bright red. Vertex and occiput purple. Prothorax and anterior margin of pterothorax black; dorsum of pterothorax usually red, infrequently dull brown; remainder of thorax olive brown. Legs reddish brown. Wings long; not deeply colored except along costa before nodus; postnodal light areas large. In place of second cubito-anal cross vein an area of anastomosing veins, usually with several running to the inner side of the triangle. Veins in base of both wings, almost to level of nodus, except near caudal margins and along costal margin of fore wing, somewhat thickened and anastomosed; bright red. Veins in remainder of wings black. Cephalic surface of anterior lamina without denticles; caudal margin almost straight, with only a shallow, angled emargination in center. Superior appendages about equal in length to segments 9 and 10, teeth elevated on a keel; inferior about two-thirds as long as superiors, sides almost parallel.

Female: Similar to male; second cubito-anal cross vein not branched; veins in reticulated areas of wings less dense and not so highly colored.

Venational indices: anc: f.w.—C 15-19 (17.04), Sc 13-19 (16.03); r.w.—

C 10-13 (11.64), Sc 10-13 (11.73). poc: f.w.—R 7-12 (9.7); r.w.—C 5-16 (13.30), R 6-13 (9.75). bc: f.w.—3-10 (6.54); r.w.—5-14 (8.45). s-tc: f.w.—6-23 (11.96); r.w.—2-7 (4.39). Cells: t: f.w.—5-23 (11.25); r.w.—4-24 (10.82). pt: 7-15 (10.69). "loop:" 5-36 (14.61). patella: ♂—17-63 (39.83); ♀—12-27 (18.63).

Measurements: ♂: abdomen—17.5-20.5 mm.; femora, second—<4 mm., third—>4.5 mm.; tibiae, second—4.5 mm.; third—<6 mm.; fore wing—22.5-28 mm., pterostigma—<3 mm.; rear wing—23-28 mm., pterostigma—3.25 mm., width, base—10.5-12 mm., nodus—9-10.25 mm. (ratio: base—2.24-2.33, nodus—2.61-2.73). ♀: abdomen—16-18 mm.; femora, second—>3.5 mm., third—>4.5 mm.; tibiae, second—>4 mm., third—<6 mm.; fore wing—23-26 mm., pterostigma—>3 mm.; rear wing—23.5-26 mm., pterostigma—>3.5 mm., width, base—10.5-11.75 mm., nodus—9.75-10.5 mm. (ratio: base—2.21-2.24, nodus—2.47-2.48).

Types: Holotype ♂—Manáos, June 10, 1922 (Mich. Mus. Zool.); allotype ♀—Maués, April, 1932 (Mich. Mus. Zool.); paratypes—all other specimens studied.

This species is named for my wife, Esther Barrett Montgomery.

Estherae is perhaps most closely related to *pullata* as these two species resemble each other more closely than either of them, especially *estherae*, resembles *emilia* or *intensa*, both in the width and the central tendency of their range of variation in the characters tabulated. However, *estherae* is distinctly separated from all other species of the *pullata*-group by the coloration of the frons, the presence of secondary reticulation of veins in the fore wing, and the form of the inferior appendage. Although *estherae* appears to have more densely veined wings than *pullata* because of the more intensive and extensive secondary reticulation, in other, and, perhaps, more definitive, areas the veins are more numerous in *pullata* (as illustrated by the number of antenodal and postnodal cross veins and the number of cells subtended by Rpl).

Teneral females of *estherae* and *pullata* are somewhat difficult to separate. There is little difference in the coloration of the frons in dried teneralis of the two species and the venational differences are not as wide in the females as in the males.

The only information available concerning the habits and habitats of this species are the notes by J. H. Williamson (1923 and unpublished field notes on envelopes containing specimens) concerning the creek where he and Strohm found it at Manáos. "Owing to the unprecedented high level of the Rio Negro, creek beds were flooded for over a mile back into the country. We collected along the busy bank of the stream which flows past the Manáos brewery, finding there many teneral libellulines . . . The back water extended inland to the old dam, built across the creek bed a half mile below the Bosque and about two miles from the river. The artificially

PLATE III



Lateral views of appendages and genitalia and ventral view of inferior appendage of males of species of *Diastatops*.—1-3. *D. obscura*, Georgetown, British Guiana, January 27, 1912.—4-6. *D. nigra*, type, Carvoeiro, Rio Negro, Brazil, July 11, 1922.—7-9. *D. maxima*, type, Teffe Ega, Brazil, November, 1921.—10 12. *D. tincla*, type (= *D. obscura*), Coll. Selys, ex Coll. Rambur (del. Elizabeth M. Heiss).—13-15. *D. maxima*?, Teffe Ega, Brazil, Coll. Selys (del. Elizabeth M. Heiss).—16-17. *D. pullata*, Brazil, Coll. Selys, probably Rambur's example of this species (del. Elizabeth M. Heiss).—18-19. *D. pullata*, type, Surinam, Museum Vienna, ex Coll. Sommer (del. B. Klein).

large à la base, fortement rétréci à l'extrémité, un peu bifide; occiput un peu plus étroit antérieurement que postérieurement, où il est arrondi et dépassé par les yeux; bouche très-saillante. Thorax d'un brun roux, luisant et un peu bleuâtre, plus foncé en dessus; bord postérieur du prothorax bilobé; lobes épais, larges. Abdomen triangulaire, pas sensiblement renflé à la base, rouge, un peu obscur en dessus; styles médiocrement longs, cylindriques, grêles, écartés l'un de l'autre à la base, un peu renflés en dessous où il existe une carène fortement dentée, naissant un peu avant la moitié de leur longueur; pièce sous-styloïde plus de moitié plus courte qu'eux, très-large, plus large que longue, assez fortement rétrécie à sa base, largement mais peu profondément échancrée à l'extrémité, dont les deux côtés forment deux angles un peu pointus. Pattes grêles, noirâtres. Ailes courtes, d'un brun roussâtre foncé, ayant un reflet d'un vert métallique en dessus, d'un bleu violet en dessous; principales nervures très-saillantes, antérieures, ayant avant le base une échancrure au bord costal; les postérieures très-larges; aréoles nombreuses, presque égales; membranule brunâtre, ptérostigma de la couleur des ailes.

De la collection du général Dejean où elle est étiquetée dux Brésil par Latreille; et de celle de M. Serville, et indiquée de Saint-Louis de Maragnon.

A small, very dark, broad winged species.

Male: Thorax black on dorsum, dark brown on sides. Legs dark brown. Wings broad; very dark, no trace of postnodal light area in fully mature specimens; no areas of thickened or anastomosed veins; veins black. Abdominal segments 1-2 black above; 1-3 black or dark brown on sides. Cephalic surface of anterior lamina smooth; caudal margin sinuate, with a deep U-shaped emargination in center. Superior appendages about as long as segments 9 and 10, teeth elevated on a keel; inferior about one-half as long as superiors, sides widely divergent.

Female: Very similar to male; veins at base of wings red; abdomen usually dark brown. Appendages about one-half as long as segment 9; slightly constricted at base; apex acute.

Venational indices: anc: f.w.—C 13-19 (15.93), Sc 12-18 (14.66); r.w.—C 8-12 (10.53), Sc 8-12 (10). poc: f.w.—R 5-11 (7.44); r.w.—C 7-13 (10.31), R 6-12 (7.87). bc: f.w.—0-6 (2.09); r.w.—0-6 (2.41). s-tc: f.w.—3-9 (5.42); r.w.—0-4 (1.37). Cells: t: f.w.—2-9 (4.56); r.w.—1-7 (3.37). pt: 4-8 (5.57). "loop": 3-10 (6.11). patella: ♂ 3-14 (8.55); ♀ 3-15 (8.06).

Measurements: ♂: abdomen—15-19 mm.; femora, second—<4 mm., third—5 mm.; tibiae, second—4.5 mm., third—6 mm.; fore wing—21-25 mm., pterostigma—3 mm.; rear wing—21-25 mm., pterostigma—3.5 mm., width, base—9.5-10.75 mm., nodus—9-9.75 mm. (ratio: base—2.21-2.28, nodus—2.33-2.51). ♀: abdomen—14.5-17 mm.; femora, second—>3.5 mm., third—<5 mm.; tibiae, second—4.5 mm., third—6.5 mm.; fore wing—20-24 mm., pterostigma—>3 mm.; rear wing—20-24 mm., pterostigma—>3.5 mm., width, base—10-10.5 mm., nodus—9.5-10 mm. (ratio: base—2.10-2.19, nodus—2.21-2.30).

Type: Lost? (The description by Fabricius, "Abdomen cylindricum," would indicate that his specimen was a female.) (Rambur's type of *tincta*, a male from Brazil, is in the de Selys Collection at Brussels.)

The specific names applied to this species by Fabricius and Rambur (*obscurus*, dark; *tinctus*, dyed, stained) indicate that they were impressed

by the dark color of these insects, as was Burmeister in his selection of a name for *pullata*.

Obscura is quite distinct from the other two, closely related, species of the *obscura*-group. Both *maxima* and *nigra* are much larger than the averaged sized *obscura*; only one specimen of the 83 of *obscura* measured, is equal in wing length to the shortest wing observed in *nigra*, although two specimens have abdomens as long as those found in *nigra* and one exceeds all specimens of *nigra* examined in this character. The three species differ but little in the venational characters tabulated. The sides of the inferior appendage are quite divergent in *obscura*, but are sub-parallel in *maxima* and *nigra*; also the row of teeth on the ventral surface of the superior appendages usually extends considerably beyond the tip of the inferior in *obscura*, but reaches only to the tip, or less, in the other two species. A very decided difference is found in the shape of the rear wing, that of *obscura* being much wider; the ratio of length to width in the male *obscura* is, at the most, 2.28:1 at the level of the loop (base) and 2.51:1 at the nodus (much less in both cases in the female), while these ratios in *nigra* and *maxima* are, respectively, 2.36:1 and 2.46:1 at the base, and 2.73:1 and 2.84:1 at the nodus.

The red color of the veins in the basal portion of the wings of the female is never very bright; in some specimens it cannot be detected without considerable magnification.

The characters of Rambur's type of *tincla* studied and recorded by Miss Heiss fall, in every case, almost in the center of the range for *obscura*. "No areas of secondary reticulation or coloration of veins. Color of frons—deep brown to black with purple florescence. Wing counts: a. Max. cell rows enclosed by Mpl, fore wing—2, hind wing—2; b. No. of cell rows between the bisector and A_2 —2 (most of the area); c. No. of cells in triangle, fore—5 on 1. 6 on right, hind—4."

As in *pullata* the specific name of this species appears very appropriate for the dried specimen but the living insect must present quite a different appearance. Kirby (1897) quoted Austen concerning this species, as follows, "The patch at the base of the hind wing and the abdomen (except tip) brilliant scarlet when alive." Williamson wrote in his field notes, Georgetown, January 26, 1912, "This species frequents lower vegetation than other (*pullata*) and walks more on twigs. Abdomen of male bright red—very handsome." In letters to Ris (1916) he added further comments on the habits of this and other species, especially "on the very peculiar habit of the 3 spp. of *Diastatops* taken by me, of walking about on twigs. I have seen nothing to compare with this in other dragonflies. I believe the more active males were the most conspicuous walkers. . . . at the Botanic Gardens in Georgetown the two species are associated. But along some of the canals through fields, *obscura* may sometimes be taken in the over-

hanging grass in considerable numbers. *Pullata* was never observed here at all. If one of these *obscura* was pursued closely but not captured, it would leave the canal and fly into the first bit of thick vegetation back from the canal bank. This vegetation might be grass, bush or any dense cover. In the interior of British Guiana I do not recall that I saw *obscura* at all."

At Belem, August 9, 1922, Williamson and Strohm found *obscura* "along wide trail in woods far from water. Generally they were fluttering about close to ground, alighting on dead leaves or twigs. When approached they flew to bushes and then to higher branches in trees or back into woods."

Diastatops nigra n. sp.

Material studied: BRAZIL: Amazonas; Maués, Rio Maués, April, 1932, 2♂ (bought from F. Wucherpfennig; Mich. Mus. Zool.); Carvoeiro, Rio Negro, July 11, 1922, 1♂ (J. H. Williamson and J. W. Strohm; Mich. Mus. Zool.).

A large, dark species.

Male: Wings rather long, uniform dark brown, except somewhat darker along costa before nodus, and slightly lighter in limited areas in apical half—a small area in center of wing just distad of nodus and a larger area along caudal margin; iridescent violet by reflected light: veins black. Cephalic surface of anterior lamina spinose; caudal margin sinuate, with a deep, U-shaped emargination in center. Superior appendages considerably shorter than segments 9 and 10, bearing 5-7 teeth, forming a keel on ventral margin; inferior about two-thirds as long as superiors, reaching slightly beyond teeth of superiors, sides almost parallel, caudal margin hollowed out into a broad arc.

Female: Unknown.

Venational indices: anc: f.w.—C 17-20 (18.33), Sc 14-17 (15.5); r.w.—C 10-12 (11.5), Sc 10-11 (10.5). poc: f.w. R 8-10 (8.71); r.w.—C 11-14 (12.33), R 9-11 (9.66). bc: f.w.—0-2 (1.16); r.w.—0-4 (1.66). s-tc: f.w.—2-4 (3); r.w.—1. Cells: t: f.w.—4; r.w.—2-3 (2.33). pt: 5-7 (6). "loop": 6. patella: ♂—7-10 (8.17).

Measurements: (♂) abdomen—18-18.5 mm.; femora; second—4 mm.; third—5 mm.; tibiae, second—4.5 mm., third—6 mm.; fore wing—25-26 mm., pterostigma—3.25 mm.; rear wing—25-26.5 mm., pterostigma—3.75 mm., width, base—11 mm., nodus—9.5 mm. (ratio: base—2.36, nodus—2.73).

Types: Holotype ♂—Carvoeiro, July 11, 1922 (Mich. Mus. Zool.); paratypes—2♂, Maués, April, 1932 (Mich. Mus. Zool.).

The specific name *nigra* (L. *niger*, black) was chosen for this species, first, because of the rather uniform dark color of the species, and, second, because the type specimen was collected on the Rio Negro.

This species is rather close to *maxima*, from which it is distinguished

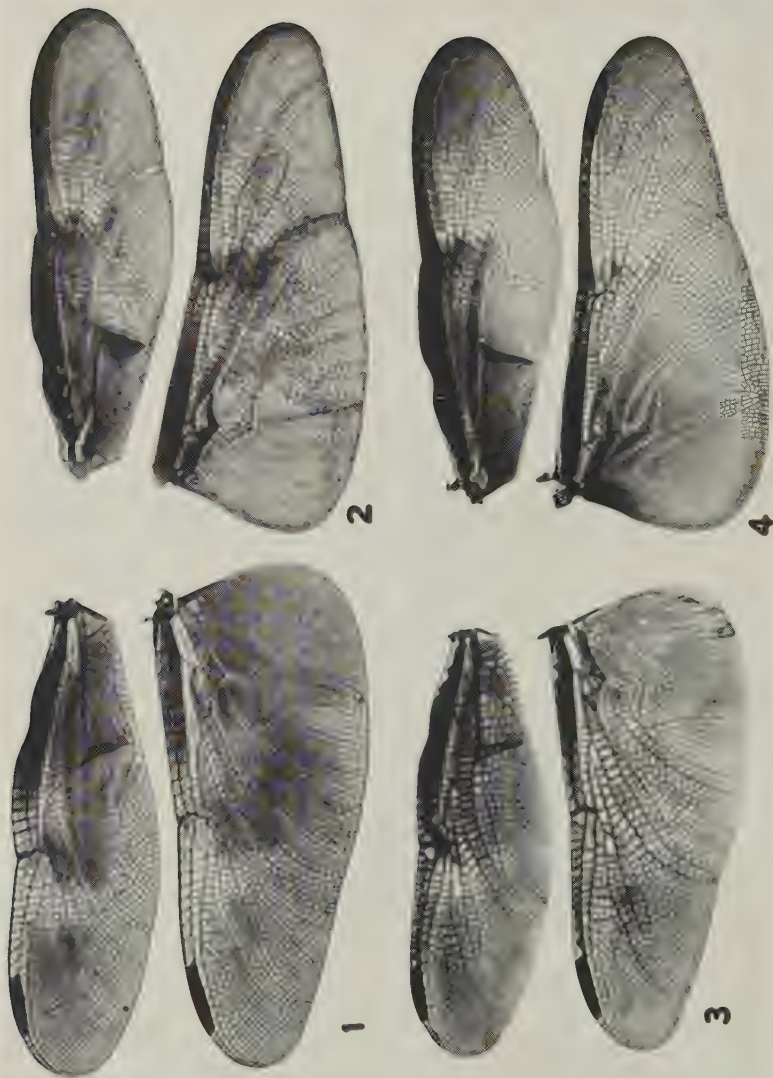


PLATE IV

(Photographs by Prof. E. J. Kohl)

1. Wings of *D. intensa*.
2. Wings of *D. pullata*.
3. Wings of *D. emilia*.
4. Wings of *D. esherae*.

chiefly by its smaller size. Slight differences in venation and in the form of the genitalia and appendages, apparent in the limited material (of both species) available for study, are well within the range of variation found within species of which a considerable number of specimens were examined.

The type specimen was damaged in the field by ants; segments 5-9 were largely destroyed, but the appendages were undamaged and enough of the dorsum remained to permit accurate measurement of the length of the abdomen. (The tip of the abdomen has been fastened to the remainder of the specimen by means of cardboard and glue.) The two specimens from Maués appear not to have been properly dried and have been damaged by mold, especially on the head and thorax.

***Diastatops maxima* n. sp.**

? *Diastatops obscura* Ris, 1910, Coll. de Selys, 11: 210 (in part).

Material studied: BRAZIL: *Amazonas*: Tefé Ega, November 1921, 1 ♂ (A. H. Fassl; Coll. Ris).

A very large, dark species.

Male: Wings long; rather uniformly dark brown, somewhat darker along the costa, especially before the nodus, and very slight "brightening up" in middle of wing distad of nodus, iridescent violet by reflected light; veins dark brown or black. Cephalic surfaces of anterior lamina spinose; caudal margin sinuate, with a deep, broad V-shaped emargination in center. Superior appendages slightly shorter than segments 9 and 10, bearing 5-6 teeth, which form a distinct keel on ventral margin; inferior reaching beyond teeth of superiors, sides almost parallel, caudal margin slightly hollowed out, forming a broadly obtuse angle.

Female: Unknown.

Venational indices: anc: f.w.—C 19, Sc 17-18; r.w.—C 12, Sc 11. poc: f.w.—R 11-13; r.w.—C 12-15, R 12-13. bc: f.w.—2-6; r.w.—2-3. s-tc: f.w.—4-5; r.w.—1. Cells: t: f.w.—4-6; r.w.—2-3. pt: 7. "loop": 8. patella: ♂—8-10.

Measurements: (♂) abdomen—22 mm.; femora, second—<5 mm., third—>6 mm.; tibiae, second—5.5 mm., third—8 mm.; fore wing—31 mm., pterostigma—4 mm.; rear wing—32 mm., pterostigma—4.5 mm., width, base—13 mm., nodus—11.25 mm. (ratio: base—2.46, nodus—2.84).

Type: Holotype ♂—Tefé Ega, September, 1921 (Coll. Ris).

The specific name *maxima* (L., maximus, greatest) has been selected for this species because it exceeds all other species of the genus in size.

This species is very closely related to *nigra*; the chief difference between them is size. Certain structural differences (in genitalia, appendages, and venation) apparent in the limited number of specimens available for study—three of *nigra* and one of *maxima*—are slight and with the exception of the number of cells subtended by Rpl in the rear wing are well

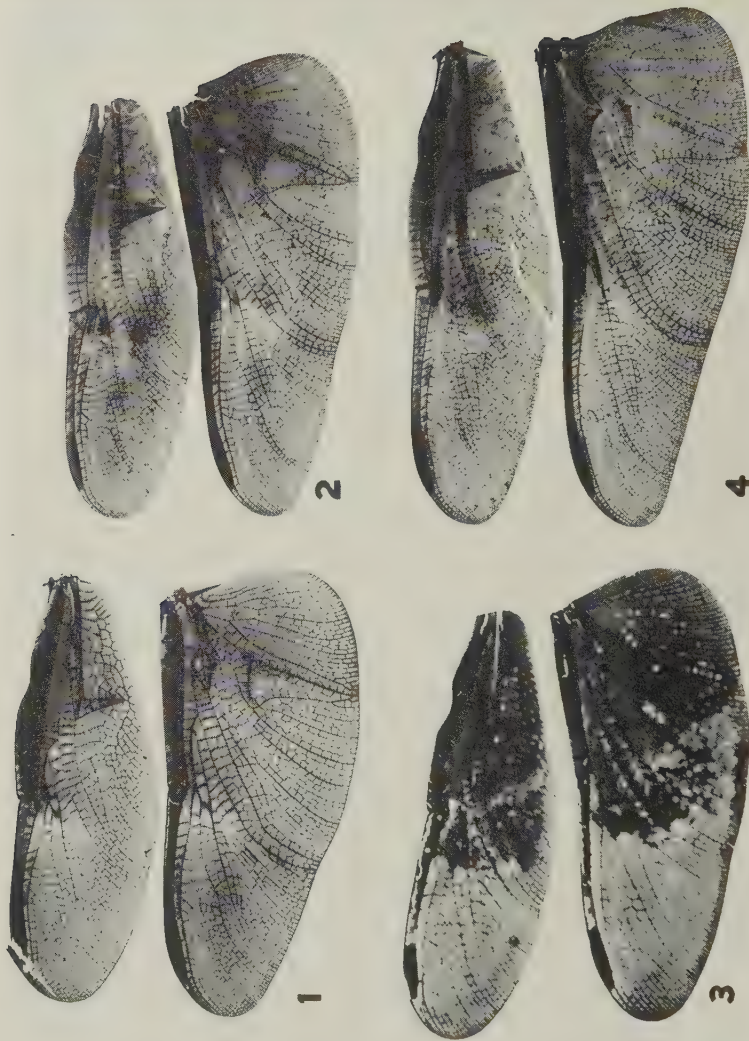


PLATE V

(Photographs by Prof. E. J. Kohl)

1. Wings of *D. obscura*.
2. Wings of *D. nigra*.
3. Wings of *D. dimidiata*.
4. Wings of *D. maxima*.

within the range of variation found within those species of which more extensive material was studied. The difference in size between the specimens is considerable (much greater than the extreme range found in any other species, if the Selysian specimen mentioned below is included in *maxima*), and in spite of my inability to find more definitive structural differences it seems imperative to treat the two forms as distinct species.

There is a specimen in the de Selys Collection which, from notes and drawings by Miss Heiss and a brief note by Ris (1910), appears to be conspecific with the one described here. It is slightly larger—abdomen, 24 mm., and rear wing, 34 mm. It also came from Ega, and was collected by Bates.

DIASTATOPS DIMIDIATA (Linné)

Libellula dimidiata Linné, 1758, Syst. Nat. (ed. X), 1: 555 (no. 14); 1786, Syst. Nat. (ed. XII), 1: 903; Fabricius, 1775, Syst. Ent.: 422; 1781, Spec. Insect., 1: 522; 1793, Ent. Syst., 2: 379; Burmeister, 1839, Handb. Ent., 2: 854.

Palpopleura dimidiata Rambur, 1842, Ins. Nevr.: 129-130.

Diastatops dimidiata Erichson, 1848, Schomburgks Reisen, 3: 584; Hagen, 1861, Syn. Neur. N. Am.: 321; Brauer, 1868, Verh. Zool. Bot. Wien, 18: 716; Selys, 1869, Pollen et Van Dam, Madag. Ins.: 16; Hagen, 1875, Proc. Bost. Soc., 18: 95; Kirby, 1890, Cat. Od.: 8; 1897, Ann. Mag. Nat. Hist., (6), 19: 601; Calvert, 1898, Tr. Am. Ent. Soc., 25: 31, 71; Ris, 1910, Coll. de Selys, 11: 309, 312, 320; Williamson, 1915, Proc. U. S. Nat. Mus., 48: 626; 1916, Ent. News, 27: 169; Ris, 1916, Coll. de Selys, 16 (2): 1110; Williamson, 1917, Tr. Am. Ent. Soc., 43: 221.

Libellula marginata De Geer, 1773, Mem. Ins., 3: 558 (pl. 26, f. 6).

Diastatops marginata Kirby, 1890, Cat. Od.: 8; Ris, 1910, Coll. de Selys, 11: 312, 319, 321.

Diastatops fenestrata Hagen, 1855, Foerhdl. Dansk, V. S.: 125; 1875, Proc. Bost. Soc., 18: 95.

Recorded distribution: South America (Kirby, 1890). GUIANA (Erichson, 1848); Essequibo (Hagen, 1861, 1875; Brauer, 1868); Wismar (Ris, 1916; Williamson, 1915, 1916, 1917); SURINAM: (Burmeister, 1839; Hagen, 1861, 1875; Brauer, 1868). FRENCH GUIANA: Cayenne (Ris, 1910). BRAZIL: Pará: (Kirby, 1897, Ris, 1910); Parana de Buyassu (Kirby, 1897).

Material studied: VENEZUELA: Cano d'Vagre, January 28, 1911, 4♂ (S. Brown; Phil. Acad. Nat. Sci.). BRITISH GUIANA: Wismar, January 30, 1912, 2♂ 2♀ (B. J. Rainey and L. A. and E. B. Williamson; Mich. Mus. Zool.); Rupununi River, September, 1913, 1♀ (Thurston Collection; Am. Mus. Nat. Hist.). BRAZIL: Pará: January 10, 1896, 1♂ 1♀ (E. E. Austen; Br. Mus.).

Original description.—*dimidiata* 14 L. alis planis a basi ad medium nigris. *Habitat in America*. *Rolander* Margo alarum etiam fuscus est, caeterum hyalinae. *Cauda duobus parvis mucronibus*.

A small, rather dark species, with peculiarly marked wings.

Male: Wings moderately broad; black from the base to a line running from nodus to approximately one cell distad of apex of loop in rear wing and to a corresponding location in fore wing; remainder of wings hyaline except for a dark marginal band about one cell wide (somewhat wider at apex, and frequently rather indistinct along caudal margin of fore wing), black along costa to pterostigma, brown at apex and along caudal margin, and a broad white band, two to four millimeters wide just distad of the basal black area; veins black. Postnodal costal cells not divided by a longitudinal intercalary vein; second cubito-anal cross vein running to inner side of triangle; sometimes the venation is very slightly more dense in areas immediately caudo-distad of triangle of rear wing than in the remainder of the wings. Cephalic surface of anterior lamina smooth with scant pubes-

cence; caudal margin almost straight, with only a slight indentation in center. Superior appendages as long as segments 9 and 10, bearing three or four short teeth on a keel below; inferior slightly more than one-half as long as superiors, reaching well beyond the teeth of the superiors, sides almost parallel, apex bifid.

Female: Very similar to male; usually without white band in wings and with veins at base of wings red. Appendages about one-half as long as segments 9 and 10.

Venational indices: anc: f.w.—C 13-17 (15), Sc 12-15 (13.54); r.w.—C 9-12 (10.77), Sc 8-12 (9.64). poc: f.w.—C 11-16 (13.41), R 7-12 (9.32); r.w.—C 10-14 (12.59), R 7-11 (9.14). bc: f.w.—3-8 (5.27); r.w.—4-8 (5.73). s-tc: f.w.—2-13 (8.59); r.w.—1-5 (2.5). Cells: t: f.w.—2-8 (5.54); r.w.—3-7 (4.86). pt: 5-8 (6.77). "loop": 6-10 (7.86). patella: ♂—2-8 (4.27); ♀—3-9 (4.86).

Measurements: ♂: abdomen—15.5-18.5 mm.; femora, second—<3 mm., third—3.5 mm.; tibiae, second—3.5 mm., third—4.5 mm.; fore wing—20-24 mm., pterostigma—3 mm.; rear wing—20-23.5 mm., pterostigma—3.5 mm., width, base—8.75-9.75 mm., nodus—8-9.25 mm. (ratio: base—2.29-2.31, nodus—2.50-2.54). ♀: abdomen—15 mm.; femora, second—<3 mm., third—3.5 mm.; tibiae, second—3 mm., third—4.5 mm.; fore wing—19-24.5 mm., pterostigma—3 mm.; rear wing—19-24 mm., pterostigma—3.5 mm., width, base—8.75-9.75 mm., nodus—8-9.5 mm. (ratio: base—2.35-2.46, nodus—2.53-2.56).

All of the specific names which have been applied to this species refer to the peculiarly marked wings; *dimidiata* (*dimidiatus*, halved, half) was used by Linné unquestionably because the wings are (about) half black, while Drury's and Hagen's names (*marginata* and *fenestrata*) were prompted by the appearance of the outer half of the wing—a clear central portion surrounded by a colored border (*marginatus*, bordered; *fenestra*, a window).

This species is entirely distinct from all other species of the genus and, alone, forms one of the three natural groups into which the species of the genus are divided.

One of the females from Wismar has the same wing coloration as the male, but in the remainder the mid-wing white band is lacking and the veins within the black basal portions of the wing are red. Although this specimen was fully mature and some of the others were teneral, these differences did not appear to be due, entirely, at least, to age; the female from Pará appears to have been fully mature, yet it does not have a trace of the white band, while the one from the Rupununi River, the most teneral of the lot, has very definite indications of this band.

This is apparently a creek species. Ris (1910) quoted Bates as finding it along "banks of creeks." Williamson (1915, 1916, 1917) also found it along a creek. "Between Wismar and Christianburg is a small stream flowing

into the Demerara River and crossed by a footpath between the two towns. In the afternoon the backward flow of the river due to tides makes this stream almost unwadeable near its mouth. We were attracted to this muddy, log-choked creek by the beautiful *Diastatops dimidiata*, which we found nowhere else. The banks of the creek are generally covered with impenetrable brush and the exposed margins are slippery and treacherous, due to the rise and fall of water over them. At places logs are piled so indiscriminately in the creek that progress is slow and difficult; and at places the overhanging bushes completely shade the stream." At this stream they "collected, among other things the beautiful *Diastatops dimidiata*, the shadowy *Epipleoneura lamina* and *fuscaenea*, and the peculiar *Cyanogomphus conchimus*. It was here also, and here alone, that we found *Neoneura bilineata*." Williamson's notes, quoted by Ris (1916), furnish some information concerning the habits of the species, and, perhaps, also indicate why specimens are comparatively rare in collections, "*dimidiata* is, I believe, the most aggravating dragonfly I ever tried to catch. They slip out of the bush along a treacherous muddy creek, and at the slightest move, back they go where only a snake can follow."

Leg Characters of Related Genera

Earlier classifications of the Libellulidae, including that by Ris, were based wholly or chiefly upon venation. For further elucidation of relationships Needham and Broughton recommended the study of special structures but confined their own work to venation thereby conducting an infinitely more limited investigation than Ris. Following their recommendation however and as part of an investigation of leg characters throughout the Odonata the author studied and tabulated the leg characters of 35 genera of Libellulidae. Included were all the genera known to be closely related to *Diastatops*, e.g., those in groups III, IV, and VII of Ris and in the Celithemini of Needham and Broughton.

The data concerning the different genera although collected over a period of five years are still incomplete, some being based upon all known representatives of the genus and others upon one or a few species. Of a few genera (rare African or Oriental forms) no specimens were available for study; for such genera a summary of the information given by Ris in the Libellulinen was used. Unfortunately, his descriptions vary greatly in completeness and accuracy and the references to leg structures are generalizations and estimations based upon observations. Although they are the result of careful work by a skilled taxonomist of wide experience, the conclusions reached by Ris are sometimes quite different from the results obtained by actual tabulation of characters.

The coxae in the Libellulidae are truncated cones, frequently more or less flattened on one or more aspects. The trochanters are cylindrical, but

are constricted near the base to form a short proximal and a longer distal segment; the juncture of the trochanter with the femur is oblique so that the dorsal surface of the distal segment is about one-half as long as the ventral. The coxae and trochanters are clothed with fine long pubescence, usually of light color.

The femora are usually flattened on the cephalic (outer) surface with definite carinae on the dorso- and ventro-cephalic edges, but otherwise rounded. The tibiae are usually flattened on all four aspects with definite carinae on all four edges; as the upper surface is narrower than the lower the segment is trapezoidal in cross section. The tarsi consist of three segments each, of which the proximal is the shortest, the distal the longest; they are flattened below but rounded above, and each bears two claws at the apex. Each claw has a rather prominent tooth on the ventral edge, usually at about two-thirds of the distance from the base to the point.

Typically in the Odonata there are equivalent rows of spines on the two ventral edges, directed downward and outward from the leg at an angle of about 60° – 70° with the perpendicular, extending from the base of the femora to the apex of the tarsi, with the spines becoming successively longer on the femora, successively shorter on the tibiae and of approximately equal length on the tarsi. However, these spines are much modified in the Libellulidae. Those of the caudal row of the femora are very slender and hair-like and the row has been doubled or tripled. The cephalic row on the first femur is almost always restricted to the distal two-thirds or one-half of the segment and the spines increase rapidly in length and spacing (that is, each spine is much longer than the preceding one and is much closer to it than to the one following). The final spine in the cephalic row on all femora is usually very slender (hair-like), strongly curved and shorter than the preceding spine in the row. On the first tibia the spines of the distal half of the cephalic row are highly modified; they are somewhat flattened, lamellate on the ventral aspect and usually approximately equal in length and strongly curved distad. There are also other rows of spines on the tibiae, usually long and very slender, a row on either side of the caudal row of spines, one just beneath the comb (of the first tibia), and another on the dorso-cephalic carina (also more or less confined to the first).

The results of this particular investigation contributed little towards the solution of this problem. Although several lines of specialization were found almost all of them were either slight or occurred in isolated genera giving little evidence of relationships or of any course of development. Perhaps, when all genera of the Libellulidae have been studied minor variations can be properly interpreted and used in the arrangement of genera.

In the Palpopleurini (*sensu* Ris) the legs are moderately long and slender and the armature conforms very closely to the general form of the family (see author's description of genus, pages 225–228). The claws are usually

rather short (long in *Diastatops*), the tooth being small and near the apex.

In the *Brachydiplax*-series (Gruppe IV) considerable specialization is present. In several genera sexual dimorphism is due chiefly to the reduction of the spines of the third, and frequently also of the second femora of the male to short denticles, viz., in *Thermochoria*, *Nannophya*, *Brachygonia* and *Porpax*. In *Porpax*, in addition to wide sexual differences in armature the legs are specialized by being densely clothed with long black pubescence.

Three genera of the *Uracis*-series (Gruppe V) were studied but no specialization other than the short, powerful form of the legs of *Nannothemis* was noted.

The species of the *Sympetrini* which were examined indicate a tendency to greater robustness of the legs and more powerful claws (*Neurothemis* and *Brachythemis* are exceptions) but show little sexual differentiation.

The genera of the *Leucorrhiniini* vary somewhat in leg structure; in *Celithemis* and *Planiplax* the legs are slender, but in the other genera they are robust or powerful. A tendency towards more luxuriant armature is strong in *Leucorrhinia* and *Brachymesia*.

As might be expected in a group standing at the top of a line of evolutionary development, much specialization was found in the genera of *Trameini* studied. Reduction in the spines of the ventral margins of the femora, especially of the third, increase in the differentiation of the dorsal margins and specialization of the tibial spines (increase in number, reduction in length, modification in form and distribution) were found in these genera. A striking modification in form, great length of the third legs with no increase in length of the others, was noted in *Ephidatia* and *Macrothemis*. Certainly, no evidence for the inclusion of these genera in the *Palpopleurini* can be found in the structure of the legs.

PALPOPLEURINI

DIASTATOPS Rambur

Species examined: *dimidiata* Linné, *emilia* Montgomery, *estherae* Montgomery, *intensa* Montgomery, *maxima* Montgomery, *nigra* Montgomery, *obscura* Fabricius and *pullata* Burmeister.

See generic description (p. 225) for detailed description of legs.

ZENITHOPTERA Selys

Species examined: *americana* Linné.

Legs moderately long and fairly slender. First femur with a cephalic row of five to seven spines on distal half, gradually becoming longer distad, except the penultimate spine very long and far distant from the preceding and the last a rather short, curved hair-like spine; a row of about 14

reddish, hair-like spines on caudal margin and similar, but less complete rows on either side. Second and third femora similar; on the second the cephalic row begins at the end of the proximal third of the segment and contains only one or two more spines than that of the first, on the third this row consists of about nine to 12 denticles, a very widely separated long spine and the final hair. First tibia with five spines before and about 10 in the comb, and about 12 in the caudal row, the more distal of these rather close-set and of fairly even length. Second tibia with about nine and 20 spines in the cephalic and caudal rows, those in the distal third of the latter rather close-set and of almost even length, forming a comb. Third tibia with about 12 and 15 spines in the two rows, those in the distal fourth or fifth of the caudal row close-set and of even length, forming a comb; spines rather short.

Claw rather short; tooth small, near the apex.

Similar in color to thorax (brown).

PALPOPLEURA Rambur

Species examined: *jucunda* Rambur, *portia* Drury, *sexmaculata* Fabricius and *vestita* Rambur.

Legs of moderate length, rather slender. First femur with a row of five or six spines on distal two-thirds or three-fourths of cephalic margin, increasing in length and spacing distad, followed by one or two slender, curved, hair-like spines, and a row of long, slender, hair-like spines on caudal margin, also similar rows on ventral and caudal surfaces. These hair-like spines are the same color as the femur—black in *portia* and *vestita*, yellow in *jucunda* and *sexmaculata*. Second and third femora similar to first, except the spines of the cephalic row more numerous (eight to 13 and about 14 respectively), and those on the proximal third of the second and all except the last on the third reduced to triangular denticles; also a few denticles among the hair-like spines on the caudal margin of the third. First tibia with four spines before and 11 in comb, and about 10 in caudal row. Second tibia with about eight and 30 in cephalic and caudal rows, those in the distal half of the caudal row very close-set. Third tibia with about 12 and 16 respectively in the two rows, spines rather short and of nearly equal length.

Claw rather short, thin; tooth of moderate size, near the apex.

Color similar to thorax; brown, becoming darker distad in the dark species, yellow, changing to brown on feet, in the yellow species.

PERITHEMIS Hagen

Species examined: *cornelia* Ris, *domitia* Drury, *electra* Ris, *intensa* Kirby, *lais* Perty, *mooma* Kirby, *seminole* Calvert, *tenera* Say and *thais* Kirby.

Legs long and rather slender. First femur with a cephalic row of five to

six spines on distal two-thirds or three-fourths of segment, gradually increasing in length distad until the last which is slightly shorter than the preceding, and at the apex a short, fine, hair-like spine; caudal margin with a row of about 10-12 long, slender, yellow, hair-like spines, also similar, but less complete rows of spines on ventral and caudal surfaces. In the female and sometimes in the male the cephalic row begins with a much smaller spine than usual. Second femur similar to first, except the cephalic spines more numerous (about 10) and extending the full length of the segment. Third femur also similar but the cephalic spines slightly more numerous (about 12) and increasing in length from the base less rapidly; frequently, however, spines of this row are missing over rather long spaces. First tibia with four spines before and eight to 10 in comb, and about 10 in caudal row; dorso-cephalic carina bearing about 15 short, rather strong, black spines. Second tibia with about eight and 14 spines in cephalic and caudal rows; third with 11 and 15 respectively; spines rather long.

Claw of moderate size; tooth rather small, very near the apex.

Yellow or light brown (dark brown or blackish with superior surface of tibiae yellow in *domitia*); thorax olive, or brown with yellowish or olive markings.

BRACHYDIPLACINI

NANNOPHYA Rambur

Species examined: *pygmaea* Rambur.

Legs long and fairly slender. First femur with a row of numerous, very short, hair-like spines on proximal half of ventro-cephalic margin, four spines on distal half, the first two rather short, the third rather widely placed and very long, and the fourth very widely placed but moderate in length, ventro-caudal margin bearing five or six hair-like spines, not all in the same row on distal third, dorsal surface with a few sparse hairs at the apex; second with eight spines in cephalic row and about 10 hair-like spines in caudal row, the latter somewhat confused and intermingled with numerous shorter, fine hairs; third with eight to 10 denticles and a spine of moderate length followed by another, shorter and hair-like, at apex, on cephalic margin and a row of 10 hair-like, almost equal spines on caudal margin, also on the caudal surface just above the latter a row of similar but shorter and more numerous spines, dorsal surface bearing a few hairs, caudal edge rounded, cephalic carinate and dentate. First tibia with four spines before and five in the comb, about 10 in the caudal row, these more or less confused with a row of hairs just ventrad, numerous hairs also on the caudal and dorsal surfaces; second with six spines in cephalic and about 15-16 in caudal row, the distal eight or 10 of the latter row approximately equal and very closely placed, also a row of short hairs just dorsad of this

row; third with about eight to 10 spines in each row, numerous short, decumbent hairs and a few long upright hairs on dorsal surface.

Claw tooth rather short, blunt, near the apex.

Dark (black or dark brown), somewhat lighter at base; thorax reddish brown with blackish markings on dorsum and near leg bases.

In the female the armature of the third femur is similar to that of the second.

BRACHYGONIA Kirby

Species examined: *oculata* Brauer (♀).

Legs long and slender. First femur smooth, except a row of five spines on the distal half of the ventro-cephalic margin, first four equally spaced and gradually increasing in length distad, the fifth widely separated and very long; second with nine spines in cephalic and 12 yellow, hair-like spines in caudal row; third with ventro-cephalic margin similar to the second, other three edges marked with carinae bearing black teeth. First tibia with six spines before and six in the comb, also six in caudal row; second with seven and nine, respectively, in cephalic and caudal rows, gradually decreasing in length distad, except last six in caudal almost equal; third with nine and 11 respectively, gradually decreasing in length.

Claw tooth rather thin, very near the apex.

Similar to thorax in color; yellow with apices of femora and bases of tibiae slightly darker; spines black except as noted.

In the male, according to Ris (1910), the third femur (ventro-cephalic) with a row of very small, rather widely separated spines and a longer spine at the end.

TYRIOBAPTA Kirby

Species examined: *torrida* Kirby.

Legs long, rather slender. First femur with five spines on distal two-thirds of cephalic margin, gradually increasing in length and spacing distad, except the last which is much shorter than the fourth, or even the third, and more slender and strongly curved, caudal margin rounded, bearing three somewhat confused rows of hair-like spines; second similar to first, except the cephalic row begins near the base of femur and contains eight spines, of which the middle three or four are about equal in length; third with nine to 11 in the cephalic row, similar to the corresponding row in the second except the first spine is reduced to a small, triangular tooth, caudal margin similar to first and second except for a row of five to eight short spines (beginning with a triangular tooth) among the rows of hairs in the distal half or two-thirds of the femur, dorso-cephalic margin carinated and bearing a few widely placed, short denticles. First tibia with five spines (decreasing rapidly) before and nine in the comb, eight spines in caudal

row, also a row of short hair-like spines just ventrad of comb; second and third tibiae with nine to 11 spines in each row.

Claw tooth rather sharp, very near the apex.

Dark brown or blackish in male, lighter in female (corresponding closely to color of thorax).

Armature of male and female identical.

BRACHYDIPLAX Brauer

Species examined: *chalybea* Brauer and *sobrina* Rambur.

Legs long and rather slender. First femur with a row of five spines, gradually increasing in length and spacing distad, on distal two-thirds of cephalic margin and a hair-like spine of moderate length at the apex, remainder of femur smooth and bare, except for a row of about 12-15 hair-like spines on caudal margin, flanked on either side by incomplete rows of shorter hairs; second with a cephalic row of 10-12 spines gradually increasing in length and spacing from a short, thick, triangular tooth at the extreme base of femur to a spine of moderate length at apex, caudal margin bearing two to four, somewhat confused rows of hairs, the number of rows greatest at apex, remainder of femur smooth and bare except a carina on the dorso-cephalic margin; third with a cephalic row of 14-16 short, thick, triangular spines, increasing in length gradually distad. caudal margin similar except denticles shorter and sometimes present only on distal half and flanked by incomplete rows of hairs, dorsal edges carinated and each bearing a row of close-set, decumbent, short teeth. First tibia with four to six spines before and eight to 11 in the comb, about 10 in caudal row; second and third each with about 10 and 15 spines in cephalic and caudal rows respectively, dorsal edges similar to those of third femur.

Claw tooth rather small, near the apex.

Dark (black or dark brown), ventro-caudal surface of anterior femora sometimes light (yellow or olive); thorax light to dark brown with rather extensive dark markings.

AETHIOTHEMIS Martin-Ris

No specimens of this genus were available for study; the following description has been compiled from Ris (1910).

Legs long and powerful. Second femur (cephalic?) with spines at base of equal length, but rapidly becoming longer after the middle; third with numerous spines, about equally spaced, gradually becoming longer, at the end a longer spine. Tibial spines numerous, long, fairly powerful.

Claw tooth large, near the apex.

RAPHISMIA Kirby

Species examined: *bispina* Hagen.

Legs long and rather slender. First femur with four spines on distal

three-fifths of cephalic margin, increasing rather rapidly in length and spacing, followed by a thin hair, and with three rows of hairs on the rounded caudal margin; second similar except the row of spines on the cephalic margin extending from base to apex, more numerous (about seven) and increasing in length more gradually; third also similar except the spines (of which there are about 10) shorter—those near the base reduced to triangular denticles and only the last one of moderate length—and the dorso-cephalic margin bearing a dentate carina. First tibia with four spines before and eight in comb, nine in caudal row, also a row of hairs just ventrad of the caudal spines; second with seven and 11 and third with 10 and 12 spines in cephalic and caudal rows respectively, the second with a row of hairs on ventral surface; dorsal edges of all tibiae carinate and dentate.

Claw tooth short, stout; near the apex.

Black, caudo-ventral surface of anterior femora olive; thorax black or black with olive markings.

CHALCOSTEPHIA Kirby

Species examined: *flavifrons* Kirby.

Legs long and slender. First femur with six spines, increasing rather rapidly in length and spacing, on distal two-thirds in cephalic row and 10–11 hair-like spines, gradually increasing in length only at the base, in caudal row; second with 10–11 spines in cephalic row, increasing gradually from triangular denticle at base to long curved spine at apex, the latter more widely spaced than the remainder of the row, caudal row consisting of 12–16 yellow, hair-like spines, flanked by rather confused rows of hairs; third similar to second, except the spines somewhat more numerous. First tibiae with eight spines before and nine in comb, about 11 in caudal row; second and third with about 12–14 spines in each row.

Claw long; tooth very prominent, near the apex.

Yellow at base, brown distad; thorax yellow and brown.

HEMISTIGMA Kirby

Species examined: *albipuncta* Rambur.

Legs long and slender. First femur with five spines followed by a slender white hair on distal two-thirds in cephalic row, the first four spines increasing in length and spacing gradually distad, the fifth very widely placed and very long, the remainder of femur smooth and bare except for three more or less complete rows of yellow, hair-like spines on caudal margin; second and third somewhat similar, but the spines of the cephalic row are more numerous (10 and 23 respectively) and extend the full length of the segment, on the third femur these spines, except the last, are reduced to recumbent, triangular teeth and a similar row without the long terminal

spine is found among the small, sparse hairs on the caudal margin; on both the second and third femora the dorso-cephalic edge is carinated and on the third the carina bears numerous close-set, triangular denticles. First tibia with five spines before and nine in the comb, nine in caudal row which is flanked with rows of white hairs; second with nine and 17 spines in the cephalic and caudal rows, the latter bordered by rows of white hairs; third with 10 spines in each row; dorsal edges of all tibiae carinate and dentate.

Claw long; tooth long and powerful, well beyond the middle.

Basal segments and ventral and caudal surfaces of anterior femora yellow, remainder black; thorax yellow with black markings.

THERMOCHORIA Kirby

Species examined: *equivocata* Kirby (var. *picta* Sjostedt).

Legs fairly long and slender. First femur with a cephalic row of five spines on distal three-fifths of segment, the first four gradually increasing in length distad, the fifth slightly shorter, thinner and strongly curved, the caudal margin bearing rows of hairs; second with a cephalic row of nine spines followed by a hair and with three rows of hairs, much confused, on the caudal margin; third with a cephalic row of 13 spines, beginning with triangular denticles at the base and increasing very slowly, the last a very distinct, although not especially long spine, and with more or less confused rows of scattered hairs on caudal margin. Second tibia with nine and 12 spines in cephalic and caudal rows, third with about 15 in each.

Claw sharp; tooth moderate in size, beyond the middle.

Coxae, trochanters and under surface of anterior femora light, remainder dark; thorax dull yellow and black.

In the female the spines of the third femur are not reduced to triangular denticles but are similar to those of second femur.

ELEUTHEMIS Ris

No specimens of this rare genus (known only from two males of one species) were available for study and the original description (Ris, 1910), from which the following has been compiled, contains little information concerning the leg characters.

Legs moderately long and rather slender. Third femur with a (cephalic?) row of rather widely placed, moderate spines, gradually becoming longer distad; second femur with somewhat longer spines. Tibial spines numerous, long and thin.

Claw tooth moderate, near the apex.

PORPAX Karsch

No specimens of this genus were available for study; however the leg armature seems to be highly specialized and Ris (1911) gave a rather complete description, from which the following has been adapted.

Legs fairly long and very robust. All femora of male thickly clothed with long, soft, black hairs; third with an extremely close-set row of very short spines on the proximal half, these gradually becoming longer from the base, and four to five powerful, fairly long, widely separated spines on distal half; second similar except differentiation slightly greater. Tibiae with about 12 spines, fairly widely separated and powerful at the beginning, crowded and short at the end. In the female the femora are clothed at the base with fairly dense long black hair; second with four small and three long, more widely separated spines; third with about eight powerful, almost vertical and slightly curved spines, gradually increasing in length from the base.

Claw short, tooth small.

NANNOTHEMIS Brauer

Species examined: *bella* Uhler.

Legs rather short and powerful. First femur with a cephalic row of four spines on the distal half of segment, the first two short, the third very long and the fourth of moderate length and strongly curved, and a caudal row of about eight hair-like spines. Second femur with a cephalic row of seven short spines, beginning with a short triangular denticle at the base and increasing in length very gradually, followed by a long spine and two hair-like curved spines, and a row of about eight to 10 hair-like spines on the rounded caudal margin. Third femur similar to second except all spines in the cephalic row before the long one near the end reduced to triangular denticles. First tibia with three or four spines before and six in the comb, and six to seven in caudal row; spines of the comb only slightly differentiated from others. Second tibia with six and 11 spines respectively in cephalic and caudal rows; third with about nine in each row. All femora and tibiae clothed with moderately long, fine black hair. Dorso-cephalic edge of second and third femora and both dorsal edges of all tibiae carinate.

Claw long and sharp; tooth short, well beyond the middle.

Black; thorax black in male, yellow and black in female.

NEPHEPELTIA Kirby

Species examined: *phryne* Perty.

Legs long and rather slender. First femur with a cephalic row of seven spines on the distal two-thirds, gradually increasing in length distad except the last one which is far removed from the preceding and very long, at the apex a curved white hair-like spine of moderate length; a row of eight to 10 white hair-like spines on the rounded caudal margin, also a similar, less numerous row on the ventral surface. Second and third somewhat similar, the cephalic row of spines extending the full length of the segment; these spines, except the long one at the end, reduced to very short triangular

denticles on the third, increasing gradually after the proximal third on the second; caudal margin of the second with about three somewhat confused rows of hairs, that of the third with only a very few scattered hairs. First tibia with four spines before and nine in the comb, and about nine in the caudal row. Second tibia with 10 and 16 spines in the cephalic and caudal rows, the distal ones of the caudal row very close-set and about even in length. Third tibia with nine to 11 spines, rather short and of almost equal length throughout, in each row. Dorsal edges of all tibiae and dorso-cephalic edges of second and third femora carinate, those of the third leg slightly serrate.

Claw long; tooth short but rather large and pointed, beyond the middle. Black; thorax black.

OLIGOCLADA Karsch

Species examined: *heliophila* Borror and *umbricola* Borror.

Legs long and slender. First femur with a cephalic row of seven spines on distal two-thirds, gradually increasing in length and spacing distad except the last which is moderate in length and hair-like; rounded caudal margin with a row of about 12 rather long, straight, slender spines, similar rows on ventral and caudal surfaces of femur. Second femur similar to first, except the cephalic row of spines extends the full length of the segment and the spines increase gradually from base to apex until the more distal ones are similar to the tibial spines. Third femur with a cephalic row of 16 spines, those on proximal half short and triangular, the remainder gradually increasing in length distad; caudal margin bearing a few denticles and a very few, weak hair-like spines. First tibia with six spines before and eight in the comb, and about 11-12 in the caudal row which is flanked on either side by a row of strong hairs. Second and third tibiae with 12-14 spines in each row. Dorsal edges of all tibiae and dorso-cephalic edges of second and third femora carinate, those of third tibiae with slight serrations.

Claw long, rather broad, very thin; without tooth.

Black, thorax black.

SYMPETRINI

PSEUDOLEON Kirby

Species studied: *superbus* Hagen.

Legs rather short and robust. First femur with cephalic row of about five spines graduated in length and spacing, on distal two-thirds of segment, followed by three or four slender, curved, hair-like spines; femur rounded backward from ventral and dorsal margins in front to a posterior edge which bears a row of about 20 rather large spines, also a partial row of similar spines just dorsad of this ridge, and another row of similar but shorter spines on ventral surface. Second femur very similar to first, except

the cephalic row of spines more numerous (10-12), extending the full length of the segment, graduated from short triangular denticles at base to long spine at apex, but not followed by hair-like spines, and the spines of the posterior edge more numerous, forming a rather confused row. Third femur flattened beneath but otherwise of usual shape, with a cephalic row of about 16 spines, most of which are short denticles, and about 11 denticles and short stout spines on caudal margin, flanked on either side by rows of scattered hairs. First tibia with four spines before and 12 in comb, and about 13 in caudal row. Second tibia with 10 and 16 spines respectively in the two rows, third with 12 and 14. All tibiae strongly carinate and serrate on dorsal margins.

Claw long; tooth powerful, well beyond the middle.

Black with brown margins; thorax mottled black and brown.

CROCOTHEMIS Brauer

Species examined: *erythraea* Brullé and *servilia* Drury.

Legs of moderate length, fairly robust. First femur with a cephalic row of four spines on distal half, rapidly increasing in size and spacing from the first, followed by two or three curved, yellow, hair-like spines; caudal margin with a row of yellow, hair-like spines, and an incomplete row of similar, shorter spines just dorsad near apex, also a row of similar, much shorter spines on ventral surface. Second tibia very similar to first, except the cephalic row of spines more numerous, extending the full length of the segment and increasing in size less rapidly; dorso-cephalic edge bearing a few short, sharp teeth on the proximal fourth. Third tibia with the cephalic row consisting of about 25 close-set denticles and a long spine at the apex, and a caudal row of about 18 denticles; dorso-cephalic edge carinate and bearing close-set, very short, sharp spines or teeth. In the female the spines of the cephalic row are somewhat longer. First tibia with four spines before and about 10 in comb, and approximately 12 in caudal row. Second tibia with about nine and 14 spines, respectively in cephalic and caudal rows, those in distal half of latter close-set and of almost equal length; third tibia with 11 and 14 spines in the two rows. All tibia strongly carinate and serrate on dorsal edges.

Claw fairly long; tooth of moderate size, well beyond the middle.

Similar in color to thorax (yellow or orange).

BRADINOPYGA Kirby

Species examined: *geminata* Rambur.

Legs short and powerful. First femur with usual cephalic row of four graduated spines on distal half and a row of hair-like spines on caudal margin. Second femur very similar to first, except cephalic row of nine spines extends full length of segment, beginning with triangular denticle and

gradually increasing in length. Third femur with similar rows on both cephalic and caudal margins, beginning with triangular denticles at base and gradually increasing in length (somewhat more rapidly in cephalic row) to spines of moderate length at apex, about 14 in each row. First tibia with four spines before and about 11 in comb, and about 11 in caudal row. Second tibia with nine and 15 spines respectively in cephalic and caudal rows, third with about 10 in each row.

Claw long; tooth long, very near the apex.

Yellow with darker margins; thorax blue.

NEUROTHEMIS Brauer

Species examined: *fluctuans* Fabricius, *fulvia* Drury, *intermedia* Rambur and *tullia* Drury.

Legs of moderate length and slender. First femur with usual cephalic row of four or five rapidly lengthening spines on distal half, followed by a slender, curved, light colored, hair-like spine and a caudal row of hair-like spines; sometimes with similar rows on ventral and caudal surfaces, but frequently without these. Second and third femora with nine and 12 spines, respectively in the cephalic rows, those on the third gradually increasing from short denticles to spines of moderate length, those on the second somewhat longer at base and increasing in length more rapidly; caudal margin of second with numerous hair-like spines in two confused rows, that of third with about 12 denticles and only scattered hair-like spines; dorso-cephalic margins carinate, serrate at base of second and throughout entire length of third. First tibia with three spines before the comb and about nine each in comb and caudal row. Second and third tibiae each with about eight or nine spines in the cephalic row, 16 and 12 respectively in caudal row.

Claw fairly long, slender; tooth rather long and pointed, almost parallel to claw, well beyond the middle.

Very similar to thorax in color (yellow or brown).

BRACHYTHEMIS Brauer

Species examined: *contaminata* Fabricius.

Legs fairly long. First femur with a cephalic row of three widely separated spines on distal half, increasing in length rapidly, followed by two or three light-colored, hair-like spines; caudal margin bearing a row of very long spines. Second femur with five triangular denticles and four rather long spines in the cephalic row and the usual confused row of hairs on caudal margin; dorso-cephalic edge with a few denticles at base, not carinate. Third femur with about 12-13 denticles followed by two or three spines on the cephalic margin and about 12 denticles just caudad of a rather complete row of hairs on caudal margin; dorso-cephalic edge carinate and

serrate. First tibia with three spines before comb and nine each in comb and caudal row. Second and third tibiae each with about eight to nine and 13-14 spines respectively in cephalic and caudal rows; dorsal edges carinate and usually rather sparsely serrate.

Claw rather short, thin; tooth of average size, slightly beyond middle.

Yellow or reddish brown; thorax olive or reddish brown.

DEIELIA Kirby

Species examined: *phaon* Selys.

Legs long and powerful. First femur with three large spines, rapidly increasing in size, on distal half, followed by several (8-9) curved hairs at apex; three rather complete and regular rows of very long hairs on caudal margin. Second femur with three to five denticles followed by six or seven spines which gradually increase in length until the last which is very long and far distant from the preceding; caudal margin with three or more rows of hairs. Third femur with 25 or more denticles followed by a long spine at the apex on cephalic margin and similar, somewhat less numerous denticles on caudal margin; in the female the denticles of the cephalic row gradually increase in length, changing to short, stout spines on distal half or third of segment. First tibia with a comb of about 12 spines, preceded by three to five long, powerful spines, and a caudal row of seven long spines. Second and third tibiae with about 13-14 spines in each row except the cephalic on the second which contains only 10; spines very long.

Claw long and powerful; tooth long and prominent, just beyond the middle.

Black; thorax black and olive brown.

PHILONOMON Förster

No specimens of this genus were available for study and Ris (1900) gave no description of leg characters, stating that they were the same as in *Sympetrum*. Furthermore, the description of *Sympetrum* included little distinctive information concerning the legs, merely noting: "Moderately long and fairly thin. Armature of the two sexes similar. . . . Tibial spines numerous, thin, fairly short. Claw thin, long tooth near middle."

LEUCORRHINIINI

LEUCORRHINIA Brittinger

Species examined: *albifrons* Burmeister, *borealis* Hagen, *dubia* Vander Linden, *frigida* Hagen, *glacialis* Hagen, *hudsonica* Selys, *intacta* Hagen, *pectoralis* Charpentier, *proxima* Calvert and *rubicunda* Linné.

Legs rather long and powerful. First femur with numerous short semi-decumbent spines on proximal third of cephalic margin, followed by a row

of eight spines about equally spaced and gradually increasing in length until the penultimate which is far distant from the preceding (about four times the usual distance) and very long, and the final one which is of moderate length, slender and strongly curved; entire ventral and caudal surfaces covered with rather long hair-like spines in somewhat confused rows. Second femur with a row of 15-19 spines gradually changing from short, close-set, semi-decumbent, triangular denticles at base to moderate lengthed, more distant, erect spines at apex; ventral, caudal and dorsal surfaces densely clothed with long, black pubescence, and cephalic surface with a few scattered hairs. Third femur similar to second, except the denticles of the cephalic row are more numerous (20-30) and extend almost the full length of the segment, increasing only slightly in length from base to apex, at the end a long erect spine. First tibia with five spines before and eight to 10 in comb, and about 10 in caudal row; dorso-cephalic margin with a row of numerous, strongly curved, hair-like spines. Second tibia with about eight and 14 spines respectively in cephalic and caudal rows; rather short and decreasing in length from base to apex much less than usual. Third tibia with a cephalic row of about 10 spines similar to those of second tibia, and a caudal row of about 30, very close-set and of equal length or even increasing slightly in length in proximal half, more widely separated and decreasing in length in distal half; rows of widely separated, long, erect hairs on dorsal margins and ventral surface. Less specialized in the female; second and third legs similar to second leg of male.

Claw long, broad but rather thin; tooth small or prominent, beyond the middle.

Black; thorax black, brown or mottled black and brown.

CELITHEMIS Hagen

Species examined: *bertha* Williamson, *elisa* Hagen, *eponina* Drury, *fasciata* Kirby, *martha* Williamson, *monomelaena* Williamson and *ornata* Rambur.

Legs long and rather slender. First femur with a cephalic row of six spines on distal two-thirds, gradually increasing in length and spacing distad, at the apex a slender, white, hair-like spine; caudal margin with about 20 long, slender, light brown spines in a confused row. Second femur similar to first except the cephalic row of spines (about 17) extend the full length of the segment, beginning with close-set, triangular denticles and the caudal margin bears a few very short, sharp teeth among the hair-like spines. Third femur very similar to second, but the denticles of the cephalic row change to typical spines only at the apex of the segment and the hairs on the caudal margin are less numerous. First tibia with four spines before and about 10 in comb, and about 15 in caudal row. Second tibia with 10 and 15 spines and the third with 14 and 17 respectively in cephalic and

caudal rows. In the female the third femur is very similar to the second, although the spines are somewhat shorter.

Claw rather long; tooth prominent, well beyond the middle.

Usually black, sometimes light brown at base becoming dark distad; thorax varying in color with the species (black, black and yellow, black and red, reddish brown, yellow etc.).

PLANIPLAX Muttkowski

Species examined: *phoenicura* Ris.

Legs very long and slender. First femur with a cephalic row of five spines on distal three-fifths, the first four about equally distant from each other and gradually increasing in length distad, the fifth far distant from the preceding and very long; caudal row of about 12 hair-like spines, flanked on either side by somewhat confused rows of similar spines. Second femur with a cephalic row of seven rather strong spines increasing in length distad and a caudal row of hair-like spines. Third femur with a cephalic row of 14 spines, the first four or five short denticles, the remainder gradually increasing in length distad, except the penultimate which is very long and separated from the preceding by about twice the usual distance and the last which is hair-like and of moderate length; caudal row similar to that of the second femur except for two or three denticles among the hairs near apex of segment. First tibia with five spines before and seven in comb, and about 12, flanked on either side by rows of hairs, in caudal row. Second tibia with 10 and 13 spines in cephalic and caudal rows; third with about 11 in each row.

Claw long; tooth near apex—almost equal with point of claw.

Similar to thorax in color (brown).

BRACHYMESIA Kirby

Species examined: *furcata* Hagen and *gravida* Hagen.

Legs long and powerful. First femur with the cephalic row of nine spines extending almost the full length of the segment (beginning not more than one-fifth of the length of the femur from the base), gradually increasing in length and spacing until the penultimate which is very long and widely separated from the preceding, and the last which is of moderate length and slender; caudal margin with three rather confused rows of numerous, long, hair-like, light brown spines. Second femur very similar to first, except the spines of the cephalic row more numerous (12-19), those at the base reduced to triangular denticles and the final hair-like spine not present. Third femur with a cephalic row of about 30 short denticles with a spine of moderate length at apex and a caudal row of similar denticles without apical spine. First tibia with four spines before and about 14 in comb, and about 15 in caudal row; dorso-cephalic carina with a row of

about 25-30 slender spines of moderate length. Second tibia with about 12 and 20 spines and the third with approximately 15 and 20 respectively in cephalic and caudal rows; those of the caudal row on the third short and less graduated in length than others. Third leg of female less specialized, similar to second, except for a row of short, stout spines on the caudal margin.

Claw long and powerful; tooth large, at about three-fourths of length of claw from base.

Black, or reddish brown at base becoming darker distad; thorax black, brown or olive.

AUSTROTHEMIS Ris

Species examined: *nigrescens* Martin.

Legs long and robust. First femur with a row of four spines on distal half, the first three equally spaced and gradually increasing in length distad, the last widely separated from the preceding and very long; caudal row consisting of yellow, hair-like spines; also a row of black hairs on ventral surface. Second femur with a cephalic row of 12 denticles (on proximal half or two-thirds) gradually becoming somewhat longer, followed by four longer teeth or very stout spines and finally after about twice the usual space a spine of moderate length; caudal row of denticles throughout. Third femur similar to second. In the female the spines of the second and third femora are of the usual type, slender spines gradually increasing in length from base to apex of segment. First tibia with five spines before and nine in comb, and a caudal row of about 10, the first of which is very long. Spines of the second and third tibiae rather short; second with eight and 11, third with 10 and 13 in cephalic and caudal rows. All legs rather densely clothed with yellow hairs.

Claw long and strong; tooth prominent, beyond the middle.

Black; thorax black and yellow.

TRAMEINI

RHYOTHEMIS Hagen

Species examined: *phyllis* Sulzer, *plutonia* Selys, *semihyalina* Desjardins, *triangularis* Kirby and *variegata* Linné-Johansson.

Legs long and slender. First femur with cephalic row of five spines on distal two-thirds, gradually increasing in length from the first, except the last two of almost equal length, in the male the first is of moderate length but in the female it is very short, at the apex a long, hair-like spine; caudal margin with three rows of long hairs. Second femur similar to first except cephalic row of nine spines extends full length of segment. Third femur with a few (about eight) widely-separated, very short denticles on proximal two-thirds of cephalic margin and at the apex a spine and a curved hair of

equal length; a few short yellow hairs on adjacent portion of cephalic surface in distal third. First tibia with five spines before comb and 12-13 each in comb and caudal row, spines of the comb much flattened and strongly curved. Second and third tibiae each with about 11 and 16 spines respectively in cephalic and caudal rows. All tibial spines very long; also the definitive tibial "hairs" long and prominent.

Claw of moderate length, thin; tooth near apex.

Black; thorax dark (black, dark metallic green, or dark brown marked with metallic green).

EPHIDATIA Kirby

Species examined: *longipes* Hagen.

Legs very slender, third pair very long. First femur with six spines on distal half of cephalic margin, the first of these of moderate length, the remainder gradually increasing in length and spacing, at the apex the usual curved, hair-like spine; caudal margin with a row of about 10 light-colored, hair-like spines beginning at the end of proximal fifth. Second femur with about nine denticles on proximal two-thirds, and six spines of gradually increasing length on distal third of cephalic margin; caudal margin similar to that of first femur. Third femur rounded except for slightly carinate cephalic edges, the usual row of cephalic spines represented by a few exceedingly small denticles and a small apical spine; caudal row of hairs limited to proximal third of segment. First tibia with seven spines preceding and eight in comb, and about 13 in caudal row; spines of the comb less flattened and more widely separated than usual. Second tibia with 11 and 17 spines respectively in cephalic and caudal rows. Third femur with cephalic row of many (more than 50) short spines of almost equal length throughout, somewhat dorsad of the margin and directed cephalad, those of the proximal fifth (about 20) very close-set, the remainder gradually becoming more widely separated; caudal row of 18 very short spines gradually decreasing in length. In the female the cephalic spines of the second femur gradually increase in length from base to apex and the cephalic row of the third tibia is similar to the caudal row.

Claw of moderate length, narrow and thin; apex strongly curved; tooth prominent, but not especially large or sharp, widely distad of middle.

Black; except coxae and trochanters dark brown; thorax brown, slightly mottled with black and dark metallic green.

UROTHEMIS Brauer

Species examined: *signata* Rambur.

Legs rather long and powerful. First femur with seven spines of increasing length on distal three-fourths of cephalic margin, usual terminal hair missing; several confused rows of hairs on caudal margin and adjacent

portions of ventral and caudal surfaces. Second femur very similar to first; cephalic row consisting of about 13 spines, gradually increasing from a short, strong denticle at base to a stout spine of moderate length at apex. Third femur with about 22-24 denticles on cephalic margin, gradually increasing somewhat in length on distal half, a short stout spine at apex, caudal margin with about 15 denticles, very small and irregularly spaced at base, becoming stouter and more regular in position near apex; dorso-cephalic edge strongly carinate and bearing numerous stout, short, pointed spines on distal half; dorso-caudal margin rounded but bearing very numerous short, pointed spines throughout its length. First tibia with about 15 spines in each row, the distal 10 of the cephalic row making up the comb; densely clothed with fine, short, yellowish hairs, but definitive hairs not prominent. Second tibia with 10 and 18 spines in the two rows, those in the more distal portion of the caudal row forming a comb; third tibia with 11 and 18; dorsal edges carinate, in the second weakly but in the third strongly serrate.

Claw rather long; tooth powerful, well beyond the middle.

Reddish brown at base, dark brown distad; thorax reddish brown.

AETHRIAMANTA Kirby

Species examined: *aethra* Ris.

Legs moderately long. First femur with seven spines on distal half of cephalic margin; gradually increasing in length from short denticle to very long penultimate spine, followed by final thin, hair-like spine of moderate length; caudal margin with two or three confused rows of rather long hairs. Second femur with seven denticles followed by seven spines of increasing length and finally a moderate hair on cephalic margin; caudal margin with long hairs. Third femur with a cephalic row of numerous denticles, gradually becoming larger, and at the end, a stout moderate spine and the usual terminal hair; caudal margin similar to that of second. First tibia with 10 spines in caudal row, five preceding and 11 in comb, the latter very close-set. Second tibia with eight very long spines on cephalic margin and eight long, followed by four much shorter ones in caudal row; third tibia similar.

Claw rather strong; tooth long, well beyond the middle.

Black; thorax dark brown.

MACRODIPLAX Brauer

Species examined: *balteata* Hagen.

Legs moderately stout, first and second pairs rather short, third long. First femur with five spines on distal half of cephalic margin, without apical hair; caudal margin with a row of about 12 hairs, adjacent rows of hairs very irregular and incomplete. Second femur with about 13 spines in

cephalic row, gradually changing from short triangular tooth at base to long spine at apex; caudal margin with several confused rows of long hairs. Third femur with about 17 short, even denticles, and a long spine at apex on cephalic margin; two rows of long hairs on or near caudal margin; dorso-cephalic margin strongly carinate and serrate; dorso-caudal margin rounded but bearing short, thick, yellowish hairs. First tibia with about 16 spines in each row, all except three of those in cephalic row in the comb, those in the distal third of caudal row even in length and close set, forming a comb, definitive hairs, especially those on dorso-cephalic margin very conspicuous. Second tibia with nine and 15 spines and the third with 13 and 16, respectively, on cephalic and caudal margins.

Claw long, strongly curved at apex; tooth long and sharp, well beyond the middle.

Black, except caudal surface at base yellow; thorax black, brown and yellow.

SELYSIOTHEMIS Ris

Species examined: *nigra* Vander Linden.

Legs long and fairly thin. First femur with cephalic row of five spines on distal half, the last one very long and quite distant from preceding; caudal row of delicate, white hairs. Second femur with a cephalic row consisting of about 21 close-set, saw-like denticles, followed by five spines; caudal margin with two to three rows of white hairs. Third femur in the male without conspicuous armature—a few very short denticles on the cephalic margin, caudal margin rounded and without spines—in the female the cephalic margin bears a row of spines which gradually become longer on the distal third. First tibia with four spines preceding and about 12 in comb, about 15 in caudal row; second and third tibiae each with 10–12 and 20 spines, respectively, in the cephalic and caudal rows, those of the third much shorter.

Claw long, point strongly curved; tooth prominent, also strongly curved, rather blunt, well beyond the middle.

Black in male, light brown becoming black distad in female; thorax black in male, light brown in female.

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Studies in Neotropical Mallophaga—Part II

New Genera and Species

M. A. CARRIKER, JR.

(Beachwood, N. J.)

Pseudocophorus n. g.

Genotype, *Pseudocophorus antennatus* n. sp.

This genus finds its closest affinity in *Philopterus*, sharing many characters in common with it, viz., shape of head, clypeal signature and structure of thorax and abdomen, but differing widely in the type of antennae and the genital armature.

The antennae are strongly dimorphic (decidedly a generic character in this group, but not in all others). The 1st. segment is greatly lengthened and swollen in the ♂, with segments 2, 3 and 4 normal and the 5th. minute, while in the ♀ the antennae are of the usual Philopteroid type. The antennal fossae are very deep in the ♂ and shallow in the ♀.

The trabeculae are small and bluntly pointed; the eyes prominent, with-
out ocular fleck; occipital, or gular plate, and pharyngeal sclerite prominent. The prothorax and pterothorax, combined, are shorter and slightly narrower than the head, each segment being much wider than long.

The abdomen contains nine segments, all clearly separated in the male, but with the 8th. and 9th. almost completely fused in the female, the suture being visible only for a short distance from the margins.

The genital armature of the male is strikingly different from *Philopterus*, although there are some species now placed under that genus which seem to be an approach towards this type. The basal plate is unusually large, three times as long as broad, and extending backward to the posterior border of the 4th. abdominal segment. All movable parts are greatly reduced in size, very compact and well sclerotized and pigmented.

The parameres are much shortened, not clasper-like, but plate-shaped at the base, and with a rounded tubercle at their tips. There are very large, broad, dorsal endomeral plates, and a well-developed, undivided ventral endomeral plate.

The genus has thus far been taken only on two genera of *Colingidae*, *Euchlornis* and *Procnias*, three species of the former and one of the latter. Superficially the parasites from the different species of hosts resemble each other closely, but careful comparison shows that all are slightly different, either in the shape of the head, thorax or abdomen, and especially in the shape of the parameres and endomeral plates. The parts of the genital armature are so minute that the differences do not, at first glance, seem to be of importance, but were these structures of the usual size, the differences would then appear very striking. Considering carefully all of these differ-

ences, it has seemed advisable to make separate species of the parasites from the different avian hosts.

***Pseudocophorus antennatus* n. sp.**

Pl. I, figs. 1, 2, 3 and 5

Types, adult ♂ and ♀, taken from freshly killed specimen of *Euchlornis arcuata*, collected at La Cuchilla, Venezuela, June 24, 1922, by M. A. Carriker, Jr. (Types in the collection of the author.)

Male: Head about as wide as long, massive in proportion to the body, and larger than the combined segments of the thorax; preantennal area short and bluntly conical, with clypeal margin flatly convex; temples convex, scarcely divergent, with posterior angles uniformly rounded; occipital margin concave, but the occiput itself slightly convex. Trabeculae small, triangular and pointed, less than half the length of the first antennal segment in the ♂; antennal fossae deeply emarginate; antennae thickened and more than half the length of head; 1st. segment much thickened and lengthened, with swollen sides; 2nd., 3rd. and 4th. thick, but not parallel-sided, and each successive segment shorter than preceding, while the fifth segment is minute, not more than half the length of 4th.

Mandibles heavy, with massive condyles, the right one with broad, three-toothed tip, and left one pointed. Eyes very prominent, clear, with a short spine; a prominent, heart-shaped occipital signature, or gular plate. Clypeal suture prominent, hyaline, and with clypeus attached by heavy, internal, chitinized bands curving around the mandibles. No hairs on pre-antennal margin, but two rather stout ones on dorsal surface between the antennal and clypeal bands; a minute hair at base of trabeculae, and all segments of antennae with several short, stout hairs; a very long, stout hair in temporal angles and about five short bristles around temporal margins.

Prothorax quadrilateral, with sides slightly divergent (more so in ♂ than in ♀), and posterior angles rounded and furnished with one long hair and a short bristle; three longish hairs laterally on posterior margin. Heavily chitinized bands along sides and posterior margin, and with the coxae almost filling the segment. Pterothorax short and wide, about same length as prothorax, with widely divergent sides, and almost as wide as head at posterior angles, which are slightly rounded and set with a very long, heavy hair; posterior margin flatly rounded and set with about 12 hairs on each side. Middle and posterior coxae also very large, the former filling the greater part of the pterothorax, while the latter are attached to the posterior margin, and appear as under the first abdominal segment.

The abdomen is small (especially so in the ♂), being shorter than the combined head and thorax, is almost globular in shape, and is widest at the sixth segment. The pleural plates are narrow, deeply pigmented, and

overlap considerably at the sutures; the tergal plates are continuous on the first five segments, but separated at the sutures by hyaline areas; on segments 6 to 8 they are much narrower internally and do not extend to the basal plate of the genital armature. The posterior angles of the abdominal segments are bluntly rounded, set with one hair in segments 2, 3 and 4; two hairs in the 5th. and three in segments 6 to 8, while the flatly convex posterior margin of segment 9 is thickly set with long, stout hairs. There are a few longish hairs on the dorsal surface, at the posterior margins of segments 2 to 8, and a great number on the ventral surface.

Legs are short and stout, especially the coxae and femora; claws of medium length and thickness; femora and tibiae with fair number of short, stout bristles. The description of genitalia under genus need not be amplified.

Female. With the exception of the antennae, the head is the same as in the male, although the trabeculae are smaller and the antennal fossae scarcely apparent. Antennae are short, about the length of the first three segments in the male; segments 1 to 3 subequal; 4 and 5 shorter, and all about of the same thickness.

The abdomen is elongated oval, much larger than in the male, and with the tergal plates continuous across all of the segments. Segments 8 and 9 are almost completely fused, although the suture is apparent at the sides. The chaetotaxy is slightly different. There are two hairs in the posterior angles of segments 2 to 4, and three to four longish dorsal hairs grouped along anterior margin of segments 3 to 7, just inside the pleural plates. There is also a dorsal patch of stiff setae in lateral portion of segments 7 and 8, and a ventral comb of short spines extending across segments 7 and 8 in the form of a much flattened V. Segment 9 is small, slightly emarginate, and without marginal hairs.

Measurements:

	Male		Female	
	length	width	length	width
Body	1.38 mm.	—	1.64 mm.	—
Head {at trabeculae}	.42 "	{.33 mm.	.49 "	{.40 mm.
Head {at temples}	.42 "	.46 "	.49 "	.50 "
Prothorax	.20 "	.29 "	.21 "	.32 "
Pterothorax	.18 "	.41 "	.24 "	.48 "
Abdomen	.66 "	.62 "	.99 "	.68 "
Antennae	.30 "		.19 "	
" (1st. segment)	.13 "	.08 "	.06 "	.05 "
Basal plate of genital armature	.29 "	.13 "		

Pseudocophorus decoratus n. sp.

Pl. I, fig. 4

Types, ♂ and ♀ adult, taken from freshly killed specimen of *Euchlornis aureopectus decora*, collected at Pueblo Viejo, Sierra Nevada de Santa

Marta, Colombia, March 6, 1914, by M. A. Carriker, Jr. (Types in collection of author.)

Differs from *P. antennatus* in the following particulars: The total length is less but the head is larger; the trabeculae are shorter and thicker; the shape of the temples and occiput is the same. The shape and size of the prothorax is the same, while the pterothorax is slightly longer and considerably wider at posterior angles, with the sides much more divergent. The abdomen is shorter and wider, decidedly more globular in shape, while the pleural plates are very narrow on segments 5 to 7, and but faintly pigmented. The parameres are close to those of *P. chasmorhynchus*, but the lateral, endomeral plates seem to be of a decidedly different shape, more nearly resembling those of *antennatus*.

The female, however, differs more decidedly from that of *antennatus*. The total length is considerably less; the head is about the same length and width at temples, but the width at base of trabeculae is much less, while the whole outline of the head is much different. The front of the clypeus is more convex; the pre-antennal margins are convex, and the trabeculae minute; the occipital margin is much more deeply incised.

One ♂ and two ♀ ♀ (including the types) were taken.

Measurements:

	Male		Female	
	length	width	length	width
Body	1.33 mm.		1.57 mm.	
Head { at trabeculae	.44 "	.36 mm.	.50 mm.	.36 mm.
{ at temples		.48 "		.50 "
Prothorax	.20 "	.31 "	.19 "	.29 "
Pterothorax	.20 "	.45 "	.22 "	.44 "
Abdomen	.62 "	.66 "	.90 "	.60 "
Antennae	.31 "		.18 "	
" (1st. segment)	.12 "	.08 "	.05 "	.05 "
Basal plate of genital armature	.26 "	.15 "		

Pseudocophorus peruvianus n. sp.

Pl. I, fig. 6

Types, adult ♂ and ♀, taken on freshly killed specimen of *Euchlornis i. intermedius*, collected at Auquimarca, Peru, February 11, 1931, by M. A. Carriker, Jr. (Types in collection of author.)

This species is also close to *P. antennatus*, the differences in size and shape of the various segments of the body being but slight.

The pre-antennal margins are slightly convex, as in *chasmorhynchus*; the temples are more convex laterally, and the posterior angle more uniformly rounded, while the occiput is more convex.

The prothorax has the sides *more* divergent, while in the pterothorax they are *less* divergent than in *antennatus*.

PLATE I

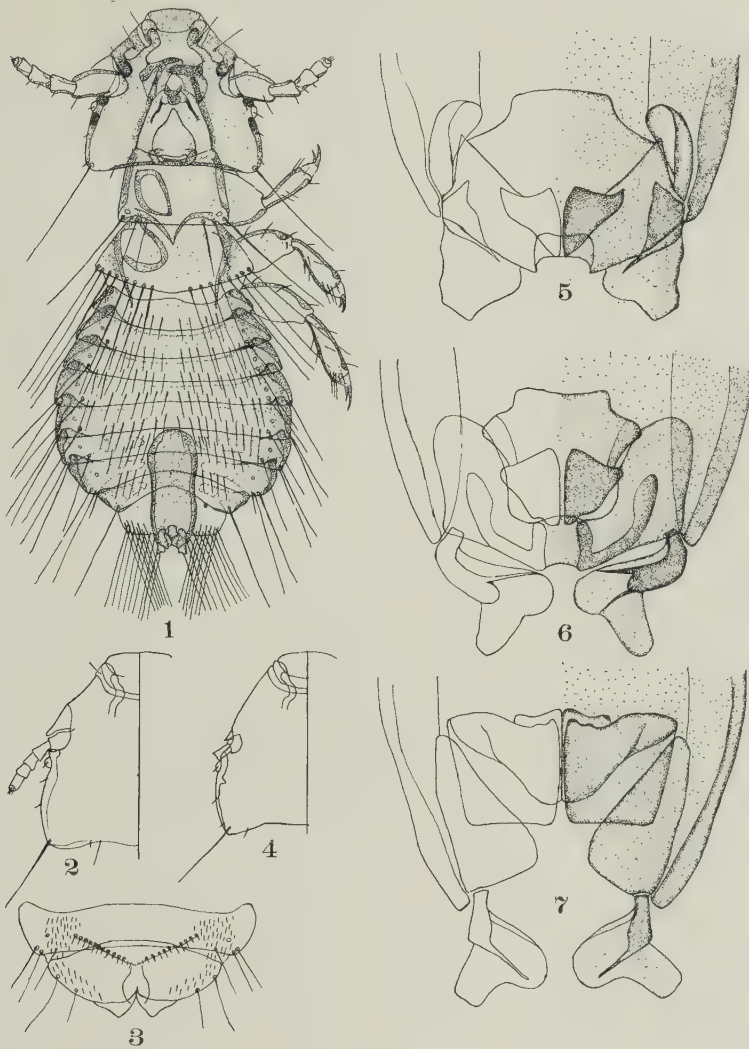


FIG. 1. *Pseudocophorus antennatus*, ♂. Fig. 2. Same, head of ♀. Fig. 3. Same, last abdominal segment ♀. Fig. 4. *P. decoratus*, head of ♀. Fig. 5. *P. antennatus*, ♂ genitalia. Fig. 6. *P. peruvianus*, ♂ genitalia. Fig. 7. *P. chasmorhynchus*, ♂ genitalia.

The abdomen is slightly wider in the male, while in the female it is both wider and longer, with the total length of the body in the female considerably greater than in *antennatus*.

The genital armature differs greatly in the shape of the different parts, especially the parameres and endomeral plates, while the basal plate is slightly longer and narrower. Three ♂♂ and three ♀♀ collected.

Measurements:

	Male		Female	
	length	width	length	width
Body	1.38 mm.		1.78 mm.	
Head {at trabeculae	.45	{.33 mm. .46 "	.48 "	{.46 mm. .52 "
{at temples				
Prothorax	.20 "	.30 "	.20 "	.33 "
Pterothorax	.20 "	.42 "	.22 "	.47 "
Abdomen	.65 "	.66 "	1.02 "	.72 "
Antennae	.30 "		.20 "	
" (1st. segment)	.12 "	.08 "	.06 "	.05 "
Basal plate of genital armature	.30 "	.12 "		

***Pseudocophorus chasmorhynchus* n. sp.**

Pl. I, fig. 7

Type, ♂, adult, taken on freshly killed specimen of *Procnias averano carnobarba*, collected at Heights of Aripo, Trinidad, Id., June 29, 1910, by M. A. Carriker, Jr. (Type in collection of the author.)

This species is represented by but a single male, the type. It differs from the male of *P. antennatus* in the following characters.

The antennae have the first segment much shorter, but equally thickened; the trabeculae are much more slender and more pointed; the lateral margins of the pre-antennal area are slightly convex, instead of slightly concave; the temples are more convex laterally, and with the whole occipital margin uniformly concave.

The genital armature differs more radically from *antennatus*, than do those of the other species of the genus. These differences are more clearly shown by the drawing than would be possible by a description. Both parameres and endomeres are of decidedly different shape and proportions, especially the latter.

Measurements:

	Male	
	length	width
Body	1.33 mm.	
Head {at trabeculae	.47 "	{.35 mm. .50 "
{at temples		
Prothorax	.18 "	.31 "
Pterothorax	.18 "	.44 "
Abdomen	.64 "	.66 "
Antennae	.28 "	
" (1st. segment)	.12 "	.09 "
Basal plate of genital armature	.31 "	.14 "

***OPISTHOCOMIELLA*¹ Guimarães**

Revista do Museu Paulista, Tomo XXIV, Art. 6, pp. 286, June 20, 1940.

Pl. II, figs. 2, 2 and 3

Genotype: *Opisthocomiella macropoda* Guimarães.*Translation of the original description:* Philopteridae of medium size;¹ A description of this genus and species had been included by me in the present paper, under

general form goniodes-like. Head much wider than long; pre-antennal region short; frontal margin flatly rounded, presenting an emargination on the median line; trabeculae small, and sharply pointed; no sexual dimorphism in the antennae; temporal margins but slightly divergent, and slightly convex; temporal angles inconspicuous; occipital margin deeply excavated, but only slightly re-entering; mandibles large and heavy, placed far forward; pharyngeal sclerite and glands present; gular plate triangular; antennal and clypeal bands forming a dark border heavily chitinized, whose internal extremities are separated on a level with the frontal emargination; temporal bands narrow; occipital bands extending from base of mandibles; a long hair in temporal angle.

Prothorax with divergent sides; postero-lateral angles rounded and set with a medium sized hair. Pterothorax much wider than head, postero-lateral angles rounded, furnished with two hairs of unequal length and one sensory hair. Pair of posterior legs much more developed than two anterior pairs, this enlargement much more accentuated in the male; claws of unequal size. This inequality of the claws particularly noticeable in the hind legs of the male.

Abdomen semi-cylindrical; pleural plates interrupted by a clear space from the 2nd. to 7th. segments, as much in the male as in the female; sternal plates continuous in the males. Genitalia very characteristic in both sexes.

The above characterization of the genus *Opisthocomiella* by Guimarães contains many characters which are purely specific and lacks others which I consider to be of generic significance. My characterization of this genus is as follows:

Nearest to *Goniocotes*, with which it agrees in the general shape of the head, thorax and abdomen, but from which it differs radically by the presence of a deep emargination on the rounded frontal margin of the head; pre-antennal region much reduced; mandibles massive, and greatly enlarged rear legs in the *male*.

The head is short and wide, with broadly expanded temples; pre-antennal region flattened, somewhat irregular in outline, and with a deep, median emargination, which is partially covered by a dorsal membrane.

Trabeculae entirely absent; antennal fossae rather deep; antennae similar in the sexes and eyes apparently wanting.

Thorax short and wide, the combined segments shorter than the head; the abdominal tergal plates divided medially, and pleural plates heavily chitinized.

the name of *Hoatzinia femoralis*, and the corrected galley-proof had been returned to the editor when he discovered that L. R. Guimarães had already published a description of it in "Malofagos da Cigana," Revista do Museu Paulista, Tomo XXIV, pp. 283 a 318, June 6, 1940. A review of the genera and species contained in it is here included which adds a new genus and species to the already considerable list which has been taken on this interesting bird.

PLATE II

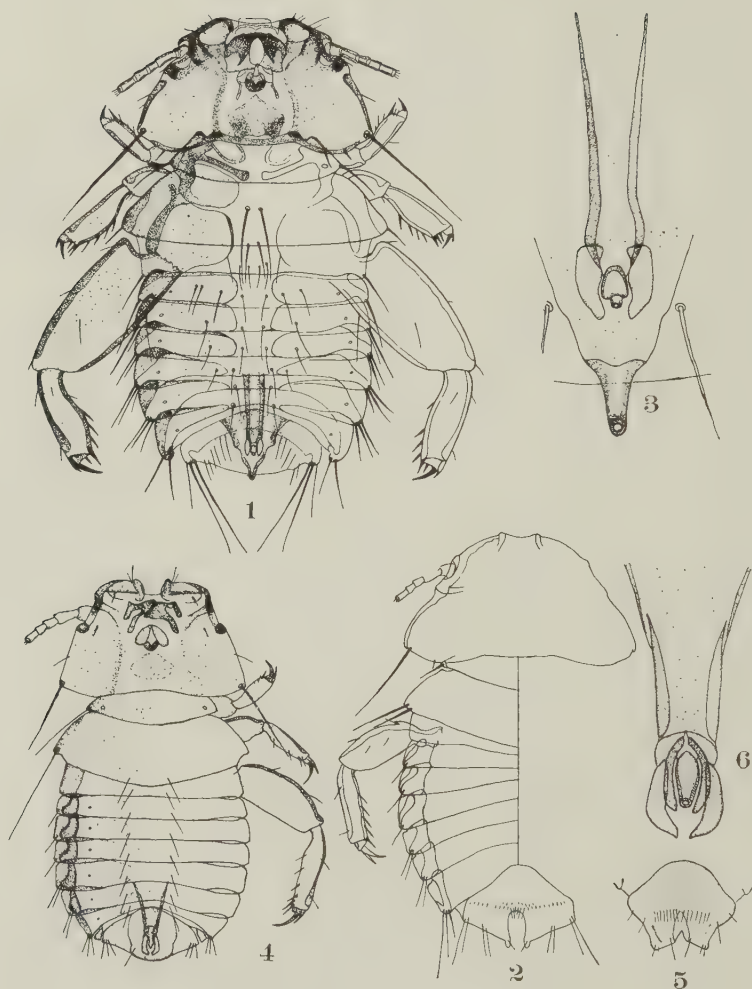


FIG. 1. *Opisthocomiella macropoda*, ♂. Fig. 2. Same, ♀. Fig. 3. Same, ♂ genitalia. Fig. 4. *Opisthocomiella curta*, ♂. Fig. 5. Same, last abdominal segment ♀. Fig. 6. Same, ♂ genitalia.

Rear pair of legs disproportionately enlarged in both sexes, but much more noticeable in the male of the genotype, while in *O. curta* they are almost equal in the sexes.

The male genitalia are small and of simple construction, consisting of a rather well developed basal plate; small, curved parameres, a median endomeral plate and penis. In *O. macropoda* the lateral endomeral plates seem to be absent or very minute, while in *O. curta* they are well developed.

The genus contains but two species, *O. macropoda* Guimarães, and

O. curta (Nitzsch). Both are found on *Opisthocomus hoazin*, usually being taken together on the same bird, but not always.

Guimarães states that small, sharply-pointed trabeculae are present. This, I think, is an error. The antennal fossae lie on the under side of the head, being covered by the dorsal integument, while there is a short, bluntly-pointed projection of the ventral integument extending partially under the first segment of the antennae, so that the antennae are actually articulated in a small groove on the side of the head. These small ventral projections under the base of the antennae cannot be classed as trabeculae.

In his description of the genotype he claims that the eyes are level with the temporal border, but as far as I can determine these organs are entirely absent.

The remainder of his description of the genotype is full and correct, the accompanying drawings being unusually clear and accurate. In a note at the end of the description Guimarães states that in two males examined by him, the 2nd. and 3rd. abdominal segments were fused on the *left side*, giving the appearance of one abdominal segment less on that side, and with two spiracles in one segment. There are no specimens in my collection which show this curious deformity.

I have specimens of this species taken from birds collected in Venezuela, Peru and Bolivia. A specimen from the Orinoco, which was selected as the type, does not agree with the measurements as given by Guimarães, and since his measurements are incomplete, I append those of the Orinoco specimens.

Measurements:

	Male		Female	
	length	width	length	width
Body	1.17 mm.		1.08 mm.	
Head { at antennae	.34 "	{ .39 mm. .62 "	.34 "	{ .36 mm. .60 "
{ at temples				
Prothorax	.14 "	.44 "	.12 "	.40 "
Pterothorax	.22 "	.69 "	.21 "	.60 "
Abdomen	.62 "	.61 "	.60 "	.62 "
Antennae	.21 "		.17 "	
Hind femora	.42 "	.20 "	.26 "	.09 "
" tibiae	.22 "	.085 "	.21 "	.06 "

OPISTHOCOMIELLA CURTA (Nitzsch)

Pl. II, figs. 4, 5 and 6

Goniocotes curtus Nitzsch, Burmeister Handb. Entomol. II, p. 432, 1838.

Goniodes curtus (Nitzsch), Zeit. f. ges. Naturw., 1866, XXVIII, p. 387.

Goniocotes curtus Nitzsch, Giebel, Insecta Epizoa, 1874, p. 189.

Goniocotes curtus Nitzsch, Taschenberg, Die Mall. Halle, 1882, p. 90.

Opisthocomiella curta (Nitzsch), Guimarães, Revista do Museu Paulista, Tomo XXIV, June 20, 1940, p. 308.

The descriptions and figures given by both Giebel and Taschenberg clearly refer to this species, and not to *O. macropoda*. Hence there can be no confusion concerning the species originally described by Nitzsch.

The female of *O. curta* closely resembles the female of *O. macropoda*, but they may be easily distinguished by the shape of the head, the deeper frontal emargination, and by the shape of the last abdominal segment.

In *O. curta* the female is larger than the male, while in *macropoda* the opposite is true. Also, in the female of *curta* the third femur is scarcely longer than the tibia (.20 mm.—.19 mm.), while in *macropoda* the femur is considerably longer (.26 mm.—.21 mm.), but *not* wider.

Another distinguishing character of *O. curta* is the straight, dorsal line (apparently a fused suture) across the front of the head (in both sexes), on a line with the inner edge of the frontal emargination.

The males are distinguished at a glance, by the enormous size of the third pair of femora in *macropoda*, and by the genital armature, *curta* lacking entirely the funnel-shaped, secondary apparatus which protrudes from the tip of the abdomen in *macropoda*. The genital armature of *curta* is of the same general type as that of *macropoda*, except that in *curta* the lateral pair of endomeres is nearly as large as the parameres. Were it not for the peculiar frontal emargination in *O. curta*, I believe it could remain in the genus *Goniocotes*. On the whole it seems to be congeneric with *O. macropoda* in spite of the differences in the genital armature and the dimorphic femora.

Measurements:

	Male		Female	
	length	width	length	width
Body	.95 mm.		1.07 mm.	
Head {at antennae	.30 "	{ .30 mm.	.28 "	{ .30 mm.
{at temples				
Prothorax	.12 "	.34 "	.12 "	.32 "
Pterothorax	.20 "	.50 "	.20 "	.50 "
Abdomen	.53 "	.51 "	.62 "	.50 "
Hind femora	.29 "	.105 "	.19 "	.06 "
Tibiae	.21 "	.06 "		

PESSOAIELLA Guimarães

Revista do Museu Paulista, Tomo XXIV, June 20, 1940, p. 300.

Genotype: *Esthiopterum absitum* (Kellogg).

Translation of the original description: Esthiopterine type of medium size, with general coloration bright yellow. Head conical, much longer than wide, with greatest length at the temples; clypeal signature distinct, in the form of a shield. Clypeal bands interrupted dorsally at clypeal suture; ventrally this band covers a portion of the lateral border of the signature; antennal fossae of slight depth; pharyngeal sclerite and glands present; occipital bands in form of a triangle, with vertices doubled backward; temporal bands narrow and faint; temporal angles rounded. Strong sexual dimorphism in antennae, 3rd. segment in male with a prolongation at distal end; eyes but slightly protuberant. Occipital margin straight.

Prothorax trapezoidal, much narrower than the head, and with a hair at the postero-lateral angles. Pterothorax with sides slightly divergent; posterior margin forming a flatly obtuse angle in median portion.

Abdomen elongated; tergal plates interrupted medially in first seven segments; sternal plates entire in male; in the female these plates are small and oval. Six pairs of spiracles.

Genital plate in female with spines along posterior margin. Genital apparatus in male apparently unique. Basal plate short; endomeres fused, forming an endomeral plate; pseudopenis "afunilado" and more compressed than the endomeral plate.

The above generic characterization contains no characters which would separate this species from several *Esthiopterine* genera. The shape of the head and body is not characteristic, nor are the antennae, and the type of male genitalia is by no means unique.

I can see no valid reason for removing this species from the genus *Esthiopterum*. It is true that the pre-antennal region of the head is somewhat different from *E. hebraeum* (N), the genotype of *Esthiopterum*, but the differences, in my opinion, do not seem to be of generic significance. I would regard, therefore, the genus *Pessoaiella* Guimarães as a synonym of *Esthiopterum* Harrison.

HOAZINEUS Guimarães

Revista do Museu Paulista, Tomo XXIV, June 20, 1940, p. 311.

Genotype: *Colpocephalum armiferum* Kellogg.

Translation of the original description: Menoponidae of medium size. Head much wider than long; front reduced and almost round. Lateral margin of the head with but a slight emargination ventrally at base of antennae; margin in pre-ocular region with a groove, surrounded by a pigmented patch; temporal lobes rounded; occipital margin with a pigmented band; pharyngeal sclerite and glands present; antennae long, with penultimate segment funnel-shaped, and last segment conical, both with scaled integument.

Thorax with three segments; prothorax almost as wide as head; posterior margin flatly rounded; lateral angles semi-acuminate. Mesothorax very small.

Metathorax trapezoidal. Coxae of front legs expanded anteriorly; femora of posterior pair with an imperfectly delineated patch of setae. Tibiae of all legs with a row of small bristles on external border of the distal portion.

Abdomen elongated oval, segments sub-equal and furnished with a row of very small hairs along posterior margin; lateral margins flatly convex, and with numerous short, stout hairs; 4th. and 5th. sternites with patches of setae, some larger, others smaller than the general chaetotaxy of the body.

Genital region of female terminating in a border of closely set hairs. Male genitalia with basal plate long and slender; parameres strong and with tips bent outward; preputial sac "(?)" conical.

The above generic characterization contains very little of generic significance outside of the presence of patches of setae on the posterior femora and on certain abdominal segments. The genital armature is not unlike many species of the genera *Colpocephalum*, *Myrsidea* and *Menacanthus*, while the shape and markings of the head are certainly typical of *Colpocephalum* or *Heleonomus*.

I have examined a large series of *Colpocephalum absitum* Kellogg. If the presence or absence of patches of setae on the hind femora and certain abdominal segments are regarded as generic characters (as now accepted by most modern authors), this species cannot be separated from the genus *Heleonomus* Ferris.

In the description of the genus *Hoazinea* the author states that the thorax is three segmented, the mesothorax being very small, and in his figure of *H. absitum* he shows a suture separating the meso- and metathorax. A careful examination of many specimens of this species fails to reveal any suture, beyond a faint indication of it on the lateral margins of the pterothorax. The meso- and metathorax are completely fused into a typical pterothorax.

I have compared this species with specimens of *Heleonomus assimile* (Piag.) and find that it agrees perfectly in all generic characters, especially in the head and in the patches of setae located on the hind femora and on the 4th. and 5th. abdominal segments. Since there is nothing to preclude its inclusion in the genus *Heleonomus*, I can see no reason for the erection of another monotypic genus for its reception.

In my conception, the genus *Hoazineus* Guimarães represents a synonym of *Heleonomus* Ferris and hence *Colpocephalum absitum* Kellogg becomes *Heleonomus absitus* (Kellogg).

EULAEMOBOTHRION OPISTHOCOMI (Cummings)

Laemobothrium opisthocomi Cummings, Bull. Ent. Res., 1913, Vol. IV, p. 42, figs. 5, a, b.

Eulaemobothrium opisthocomi (Cummings), Guimarães, Revista do Museu Paulista, Tomo XXIV, July 15, 1940, p. 308, figs. 25, 26.

Guimarães is quite correct in placing this species under *Eulaemobothrion*, since it possesses the strong, flattened hairs on the dorsal surface of the pronotum, the principal character on which the genus was separated from *Laemobothrion*.

In addition to the interesting new genus and species described by Guimarães (*Opisthocomiella macropoda*), I have recently added another genus and a new species to the already formidable array of the ectoparasites of this curious host, viz., an undescribed species of the genus *Menacanthus*, of which a ♂ and 3 ♀♀ were taken in Bolivia.

The particular bird which harbored this new parasite also yielded *all* of the remaining known species which have been described from the Hoatzin, viz., *Eulaemobothrion opisthocomi* (Cummings); *Esthiopterum absitum* (Kellogg); *Opisthocomiella macropoda* Guimarães; *O. curta* (Nitzsch); *Heleonomus armiferum* (Kellogg).

A total of five genera and six species is now known from this amazing bird.

Menacanthus megaspinus n. sp.

Pl. III, figs. 5 and 6

Types, ♂ and ♀ adult, taken on *Opisthocomus hoazin*, collected at Todos Santos, Rio Chaparé, Bolivia, August 11, 1937, by M. A. Carriker, Jr. (Types in collection of the author.)

Diagnosis: The present form appears to be quite distinct from any described species. Very few known species of *Menacanthus* have the head shaped like the present one, which resembles much more the commoner forms of *Myrsidea*. The genitalia seem to be more or less unique, and decidedly different from any other species of the genus which I have seen.

There are combs of fine setae on either side of abdominal segments 3, 4 and 5, as well as on the posterior femora. The spinous processes arising from the base of the labial palpi are unusually long and heavy, and deeply pigmented. The ocular fringe of hairs is well-developed; numerous longish hairs on the head and thorax, and the abdomen with many hairs on both dorsal and ventral surfaces.

The genitalia are small, poorly chitinized and rather difficult of interpretation. The basal plate is short and rather broad, with a purse-like sac protruding from its posterior portion, while the parameres are very short and slender, lying alongside the basal portion of the protruding sac, and with their slender, pointed tip curving *outward*.

The female is considerably larger than the male, but with the abdomen of similar shape, while the same combs of setae are present on the same abdominal segments and on the femora.

The accompanying figures give a better idea of the detailed structure of the species than would a minute and lengthy description.

Measurements:

	Male		Female	
	length	width	length	width
Body	1.34 mm.		1.60 mm.	
Head	.34 "	.55 mm.	.38 "	.61 mm.
Prothorax	.24 "	.38 "	.28 "	.42 "
Pterothorax	.14 "	.46 "	.15 "	.50 "
Abdomen	.78 "	.68 "	1.02 "	.88 "
Spines on head	.08 "	.03 "	.106 "	.038 "

Genus PARAGONIOCOTES Cummings

Ann. and Magazine of Nat. Hist., Ser. 8, Vol. XVII, January, 1916, p. 101.

When Cummings described this genus he failed to designate the geno-

type, merely saying that the genus was known to him from several species, one of which had hitherto been described by Piaget under the name of *Goniocotes fasciatus*, but that it was a simple member of the genus in which the "two large recurved frontal processes, one on each side of the head, so characteristic a feature of the new species about to be described, are absent."

Harrison, later designated *P. gripocephalus* as the genotype, which fortunately fixes the generic name of *Paragoniocotes* and leaves no confusion, since *Goniocotes fasciatus* Piaget is certainly not congeneric with *P. gripocephalus* Cummings.

Cummings' characterization of the genus is very inadequate, the characters which he uses being very vague and indefinite, and more specific than generic. He says: "Head broader than long. Front margin circular, temples rounded, with an elongate bristle. Prothorax narrow, abdomen short and small. Small species infesting parrots."

I have before me adequate series of several species of the genus *Paragoniocotes*, all taken on South American parrots, one species of which is quite close to *P. gripocephalus*. I believe that one of the strongest generic characters of this genus is the presence of the heavy, curving, spine-like processes arising from each side of the frontal margin, and curving backward and inward under the first segment of the antennae, but *within* the antennal fossae. This is the same character which is so outstanding in the genera *Physconella* Paine and *Physconelloides* Ewing, and which alone seems to me to be sufficient to separate this group from its near relatives. I would therefore characterize the genus *Paragoniocotes* as follows:

Antennae subequal in the sexes, without appendages; frontal margin of head much flattened and clypeal area much reduced, the massive mandibles being located near the front of the head; temples expanded and rounded; a heavy, curving, spine-like process arising at each side of the frontal margin of the head and curving backward and inward, under the first antennal segment, the point ending within the antennal fossae; whole thorax smaller than the head; the meso and metathorax completely fused; male genitalia very large, with basal plate nearly one third the width of the abdomen; parameres massive and penis well developed. Small species found on American parrots.

Dimorphia n. g.

Genotype: *Dimorphia mirabilis* n.sp.

Closely related to *Paragoniocotes* Cummings, with which the female agrees in the character of the curving spines at base of antennae, but in the male these hooks are replaced by well developed trabeculae, while the first segment of the antennae is enormously developed. In *Paragoniocotes* both sexes have the curved spines on the head, instead of trabeculae,

while there is very little difference between the sexes in the size of the antennae. The genital armature is of an entirely different type, being highly specialized and of a type hitherto unknown to me. Both the trabeculae of the male and the hooks of the female seem to be slightly movable, they having been noted in slightly different positions in different individuals.

On the dorsal surface of the last abdominal segment of the female, on either side of the genital plate, is a cluster of three long, curving spines. Cummings makes no mention of such spines in *Paragoniocolles gripocephalus*, although such spines are present in the female of four undescribed species of this genus which are in my collection. In *Paragoniocolles* the spines are set on the *posterior margin* of the last segment and *not* on the dorsal surface well forward in that segment, as in the present genus.

The genital armature extends forward to the 4th. abdominal segment, and consists of a basal plate, well developed parameres, and two pairs of large endomerall plates, the dorsal pair being much longer than the parameres. The penis is apparently absent, but there is a pair of short, pointed appendages lying on top of and at the base of the parameres which I am unable to define. There seems to be a membrane stretched across the posterior part of the genitalia, attached on either side to the tips of the parameres, and pierced medially by the dorsal endomerall plates, while the ventral endomerall plates protrude slightly through it, or under it, just in front of the tips of the parameres.

The re-characterization of the genus *Paragoniocolles* Cummings, as given above, will apply equally well to *Dimorphia*, with the exceptions herewith noted.

***Dimorphia mirabilis* n. sp.**

Pl. III, figs. 1, 2, 3 and 4

Types, ♂ and ♀ adult, taken on freshly killed specimen of *Ara ararauna*, collected at Chatarona, Dept. Beni, Bolivia, September 18, 1934, by M. A. Carriker, Jr. (Types in collection of the author.)

Male: Head large, with pre-antennal area very short, and front flatly rounded; temples rounded and slightly expanded laterally and posteriorly; occiput concave. Trabeculae large and slightly movable.

Antennae large, with first segment much elongated and swollen, but without appendages; 2nd. segment much smaller than first and each succeeding segment smaller than preceding. Mandibles strong, but not massive. Pharyngeal sclerite well-developed, as well as gular plate; eye rudimentary.

Thorax small, the combined segments considerably smaller than head. Prothorax quadrilateral, sides slightly sinuate and divergent, with posterior margin rounded.

PLATE III

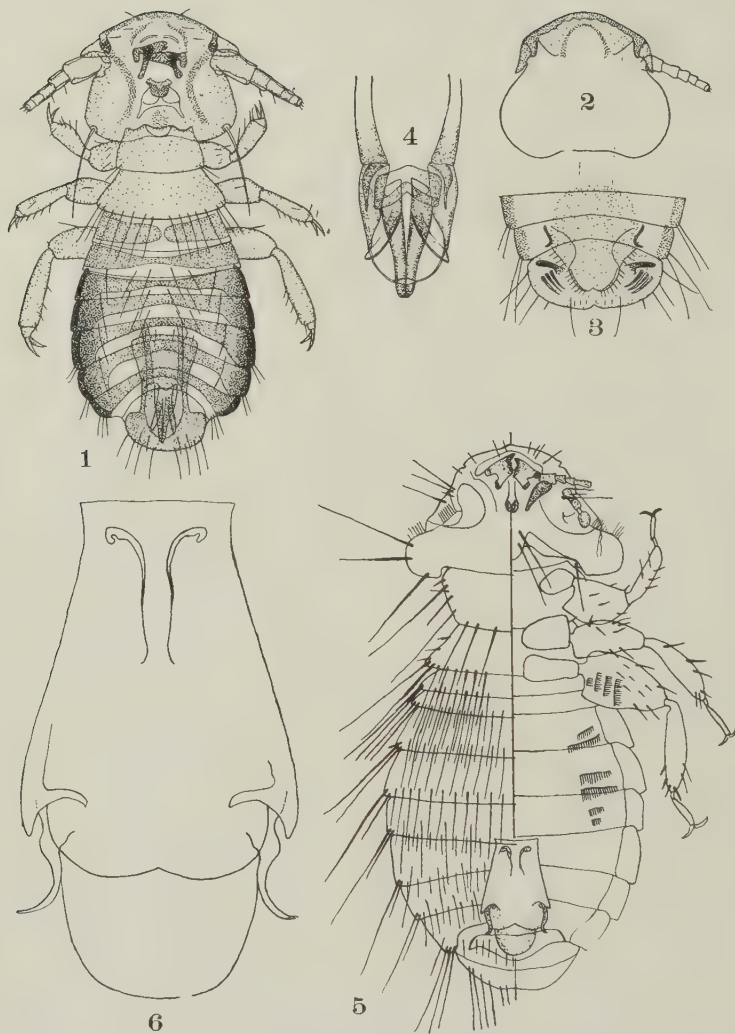


FIG. 1. *Dimorphia mirabilis*, ♂. FIG. 2. Same, head of ♀. FIG. 3. Same, last abdominal segment ♀. FIG. 4. Same, ♂ genitalia. FIG. 5. *Menacanthus megaspinus*, ♂. FIG. 6. *Menacanthus megaspinus*, ♂ genitalia.

Abdomen short, slightly wider than head, roughly oval in shape and with postero-lateral angles rounded and but slightly protuberant. Last segment much the narrowest, rounded posteriorly, and rather deeply imbedded in the 7th. Segments 5 to 7 are sharply bent forward in median portion. Pleurites continuous with tergites, but the latter are widely separated by hyaline margins of segments.

Legs of medium length and thickness, with not a great deal of difference

in size between the pairs, and with a few short bristles on tibiae and femora.

Chaetotaxy: Three short hairs on each side of dorsal surface, on the pre-antennal area and a long, stout hair, set in a pustule at the temples. First three segments of antennae with a short hair on each, and a few at tip of 5th. One weak hair in posterior angle of prothorax; a series of about 14 longish hairs along posterior margin of pterothorax. Apparently there are no hairs in the lateral angles of the first four abdominal segments, but Nos. 5 and 6 have two short ones, the 7th. three, while number 8 has four longer hairs on each side of posterior margin, and two short ones on dorsal surface. There is a longish hair at inner edge of pleurites, on posterior margins of segments 2 to 6, while segments 2 to 5 have about four hairs on median, hyaline portion.

Genital armature: This has been fully described under the generic description, and needs no further comment.

Female: Differs from the male as follows: Movable trabeculae replaced by heavy, spine-like processes which curve backward under the base of the antennae to the posterior margin of the deep antennal fossae. The antennae are filiform, with the first segment but slightly larger than the second.

The abdomen is much longer and more parallel-sided, with the 8th. segment twice as long and almost as wide as the 7th., broadly rounded, and with a slight median emargination. The genital plate is large, and shaped like a short, squat bottle pointing backward, and with a row of short hairs along the posterior margin, which extend backward to the anterior margin of the 8th. segment. On the dorsal surface are three long, very heavy, curving spines, which curve backward and inward. These spines are set in the lateral portion of the segment, near the anterior margin, and just forward of their bases lie two small, hook-shaped, heavily chitinated plates.

The pleural plates are similar to those of the male, except that they are thickened and heavily chitinated along their lateral borders. The tergal plates are not entire, as in the male, but divided medially by a wide hyaline area in all segments except the 8th.

Measurements:

	Male		Female	
	length	width	length	width
Body	1.18 mm.		1.58 mm.	
Head	.35 "	.39 mm.	.40 "	.44 mm.
Prothorax	.16 "	.23 "	.15 "	.34 "
Pterothorax	.15 "	.34 "	.13 "	.37 "
Abdomen	.64 "	.49 "	.82 "	.45 "
Antennae	.22 "		.18 "	
" (1st. segment)	.10 "	.06 "	.045 "	.043 "

Hypocrypturellus n. n.

Shortly after the publication of my monograph on the Lice of the Tinamous, Mr. Paul H. Oehser, of Washington, called my attention to the fact that one of the names I had used for a new genus was preoccupied, viz., *Hypocryptus* Carriker, Proc. Acad. Nat. Nat. Sciences Phila., Vol. LXXXVIII, 1936, page 178, with the genotype of *Strongylocotes* (*Lepidophorus*) *coniceps* Tasch. The name had previously been used in Hymenoptera: Ichneumonidae, by A. Förster, Verh. Ver. Rheinlande, vol. 25, p. 198, 1868. I therefore now propose the name *Hypocrypturellus* for *Hypocryptus* Carriker, 1936.

CUCLOTOGASTER LATICORPUS Carriker

Proc. Acad. Nat. Sciences Phila., Vol. LXXXVIII, 1936, p. 67, Text plate I, fig. 2.

This species was made the genotype of a supposedly new genus, and was collected from *Crypturellus s. soui*, El Callao, Venezuela. The type was a female, no males having been taken. A second female was in the collection which was taken from *Crypturellus soui modestus*, on the Rio Sixola, Costa Rica.

Miss Clay later called my attention to the fact that this species seemed to resemble very closely the ordinary chicken louse, *Lipeurus heterographicus* Giebel, for which she had recently erected a new genus, *Gallipeurus* (P. Z. S. 1938, vol. 108, pt. 2, p. 135).

She requested me to compare the type with *Lipeurus heterographicus*, and report the results. I did so, and found them to be identical. However, since *Lipeurus heterographicus* had already been made the genotype of *Gallipeurus* Clay, which is unquestionably a valid genus, the generic name *Gallipeurus* Clay becomes a synonym of *Cucлотogaster* Carriker, while the species *Cucлотogaster laticorpus* Carriker becomes a synonym of *Cucлотogaster heterographus* (Giebel).

It will always remain a mystery to me how those two specimens of *C. heterographus* were taken on two individuals of *Crypturellus*, and at such widely separated localities. My only explanation is that both specimens of the Tinamou were shot in thick brush near the outskirts of settlements where domestic fowls were abundant, and strayed far into the surrounding shrubbery, and that the Tinamous may have used the same "dusting" spot which had been used by a domestic fowl, and picked up the parasite there.

NIRMOCOTES Carriker

Proc. Acad. Nat. Sciences Phila., Vol. LXXXVIII, 1936, p. 78.

Genotype: *Nirmocotes orbicularis* n. sp.; host, *Crypturellus tataupa*, Marajo, Brazil.

This genus was created for what appeared to be four species of lice, closely related to *Strongylocotes*, but differing from it so materially that it

seemed advisable to place them in a separate genus. Two of these species were represented by a single immature female (?); the third by two immature females; and the fourth by four females and one male, also immature, but much more nearly adult than the others.

I was not entirely convinced that these species had been properly allocated, but decided to leave them temporarily as published.

Col. Meinertzhagen later called my attention to their resemblance to *Strongylocotes*, and suggested that they might possibly be the young of that genus, but as material was still lacking to substantiate this supposition, nothing could be done at that time.

However, in a collection of Mallophaga recently made by me in Mexico for the Smithsonian Institution, I find a splendid series of specimens of an apparently undescribed species of *Strongylocotes*, where all stages of development are present, from the very young to the adult. In the younger stages we have typical examples of "*Nirmocotes*," which later assume all of the characters of *Strongylocotes*.

Therefore, I am now fully convinced that all specimens described by me under the generic term of *Nirmocotes* are, in reality, forms of *Strongylocotes*, and the synonymy of the group should stand as follows:

Nirmocotes Carriker, 1936 equals: *Strongylocotes* Taschenberg, 1882 (juv.)

Nirmocotes orbicularis Carriker (p. 79) = *S. complanatus* (Piaget) juv.

N. glabrous Carriker (p. 82) = *S. complanatus* (Piaget) juv.

N. cordiceps Carriker (p. 83) = *S. cordiceps* (Carriker) juv.

No species of *Strongylocotes* has been recorded from this host (*Tinamus m. major*), so that we do not know the adult, which will have to be re-described under the name of *S. cordiceps* (Car.), whenever material is available. It will probably be of the general type of *S. subspinosus* or *S. angulocapitis*, since the recently collected specimens of this genus on *Tinamus major robustus*, from Mexico, have the triangular shaped head typical of those forms, with the median spur on the clypeal band absent.

Nirmocotes nirmoides Carriker (p. 80) equals *Strongylocotes complanatus* (Piaget) juv. I have recorded two species of *Strongylocotes* from *Crypturellus obsoletus punensis* (host of *Nirmocotes nirmoides*), viz: *S. c. complanatus* and *S. subconiceps*. The single male of *subconiceps* came from a bird shot at Calabatea, Bolivia, while the host of *Nirmocotes nirmoides* was collected at La Oroya, Peru, and no adult specimens of *Strongylocotes* were found on it. Furthermore, a careful comparison of *Nirmocotes nirmoides* with *S. c. complanatus* and *S. subconiceps* shows that in all probability it is the immature of the former, rather than the latter.

PSEUDOLIPEURUS MACROGENITALIS (Barros Netto)

Esthiopternum macrogenitale, Contribuição ao estudo genero *Esthiopternum*.
Faculdade de Medicina de São Paulo, 1933, p. 43, Pl. VIII-IX.

This species is a typical *Pseudolipecurus* and very close to *P. genitalis* Carriker. The genital armature is almost identical in every respect; the

antennae are practically the same, the only apparent differences being in the shape of the head and the pterothorax. It is possible that *genitalis* will prove to be a subspecies of *macrogenitalis*, but specimens must be compared before this can be definitely settled.

P. genitalis differs from *macrogenitalis* in having a longer head with much narrower temples; the pterothorax is wider in the posterior portion, having the sides divergent (posterior to the meso-metathoracic suture), while in *macrogenitalis* this segment is narrower at the posterior end than at the suture. There seem to be differences in the shape of the clypeal signature, but this is not clear from the description or figure. Until careful comparison can be made between specimens of the two forms, I consider it better to leave them as distinct species.

STRONGYLOCOTES LIMAI Guimarães

Folia Clinica et Biologica, Anno VIII, 1936, No. 2, S. Paulo, p. 48.

(Collected on *Crypturellus undulatus vermiculatus* and *C. u. undulatus*.)

Although I have not seen specimens of this species, I am convinced that it is the same as *S. complanatus interruptus* Carriker (1936, p. 85).

The type of *S. c. interruptus* was taken on *Crypturellus atrocapillus*, but specimens of the parasite from *C. u. undulatus* proved to be inseparable.

Guimarães informs me that the publication containing the description of his species appeared on May 10, 1936, while my own was dated March 31 of the same year, thus giving priority to *S. complanatus interruptus* Carriker, of which *S. limai* Guimarães becomes a synonym.

Guimarães deserves credit for having rejuvenated the generic name *Strongylocotes* of Taschenberg simultaneously with the author and using it in its proper place.

GONIOCOTOCANTHUS Guimarães

Revista do Museu Paulista de Universidade de S. Paulo, Tomo XX, 1936, p. 225.

This genus was proposed for a new species of louse collected on the Ground Dove, *Columbagallina m. minuta*. Guimarães must certainly have overlooked the genus *Physconelloides* Ewing, when he published this paper.

There is no question but that the two are congeneric, although the species *G. mattogrossensis* Guimarães, from *Columbagallina*, is distinct from *P. ceraticeps* Ewing, from *Leptoptila ochroptera*.

Therefore, *Goniocotocanthus* Guimarães, 1936, becomes a synonym of *Physconelloides* Ewing, 1927, and *Goniocotocanthus mattogrossensis* Guimarães becomes *Physconelloides mattogrossensis* (Guimarães).

The Genus *Allomyces* in Cuba

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Allomyces is a genus of filamentous fungi, belonging to the Order Blastocladales of the aquatic Phycomycetes. Originally discovered in India (Butler, 1911), the type species, *A. arbuscula*, has since been not infrequently collected in the tropical, subtropical, and temperate regions of both the eastern and western hemispheres. Two other species of less common occurrence have been described: *A. moniliformis* Coker and Braxton (1926) from North Carolina, and *A. javanicus* Kniep (1929) from Java.

To the writer's knowledge, no species of *Allomyces* has previously been found to occur in Cuba. In July, 1940, a number of soil samples from the vicinity of the Atkins Institution of the Arnold Arboretum, located at Soledad, Cienfuegos Province, were collected through the courtesy of Dr. Vincent G. Dethier and forwarded to the writer for examination. This material consisted of mud from the banks of small creeks in the immediate vicinity of Soledad, as well as one collection¹ from a creek near the Mina Carlota, an abandoned copper mine in mountainous country at some distance from Soledad.

The samples of soil were placed in sterile Petri dishes to which sterile distilled water and boiled hemp seeds were then added. The seeds on which mycelial growth occurred after several days were thereupon transferred to fresh water in new culture vessels. Through several repetitions of this procedure, six strains of *Allomyces* were isolated from the different collections of soil.

As a preliminary aid to the identification of the six isolates, the resistant sporangia borne on the asexual mycelia of the fungi were measured; the length and width of a random sample of 100-150 resistant sporangia being measured with an ocular micrometer previously calibrated against a standard. Confirmation of the species identification of each isolate was then obtained by germinating the resistant sporangia and observing the nature of the plants produced.

The three species of the genus mentioned above may be characterized as follows:

A. arbuscula Butler (1911) em. Hatch (1933).—Resistant sporangia ovoid, small, $25-35 \times 35-45\mu$, on germination giving rise to zoospores forming sexual mycelia bearing paired gametangia; the grayish female gametangium terminal with respect to the orange pigmented male gametangium.

A. javanicus Kniep (1929).—Resistant sporangia ovoid, larger than in *A. arbuscula*, $35-45 \times 45-60\mu$, on germination giving rise to zoospores forming

¹ The isolate obtained from this collection is designated Cuba 6.

sexual mycelia bearing paired gametangia; the orange pigmented male gametangium terminal with respect to the grayish female gametangium.

A. moniliformis Coker and Braxton (1926) em. Emerson (1938).—Resistant sporangia elongate, mostly pointed at the apex, $30-40 \times 55-70\mu$, on germination producing zoospores which do not form sexual mycelia, but encyst, liberating a group of four "secondary" zoospores from each cyst.

Four of the isolates obtained (Cuba 1, Cuba 2, Cuba 3, and Cuba 6) were referable to *A. arbuscula*, which, as already mentioned, is by far the most common species of the genus and the most cosmopolitan in its distribution. Of the two remaining isolates, one (Cuba 5) was found to be *A. javanicus*, and the other (Cuba 4) proved to be *A. moniliformis*. Thus all three species of the genus were found to occur in Cuba, although the number of collections made was relatively small.

Measurements of the resistant sporangia of the Cuban material are presented in the following table, together with data previously published (Wolf, 1939) on a number of Mexican isolates and included for purposes of comparison.

TABLE 1. Measurements of the resistant sporangia of isolates of *Allomyces* from Cuba and Mexico

Isolate	Species	Width (Mode in μ)	Length (Mode in μ)	75% or more between	
				Width (μ)	Length (μ)
Cuba 1	<i>A. arbuscula</i>	27	39	26-31	36-43
Cuba 2	<i>A. arbuscula</i>	30	41	27-34	38-44
Cuba 3	<i>A. arbuscula</i>	29	43	26-32	39-48
Cuba 6	<i>A. arbuscula</i>	28	39	26-32	34-41
Mexico 26	<i>A. arbuscula</i>	34	45	28-37	38-48
Mexico 29	<i>A. arbuscula</i>	34	43	28-38	38-48
Mexico 37	<i>A. arbuscula</i>	34	45	28-38	40-50
Cuba 5	<i>A. javanicus</i>	39	49	34-43	43-55
Mexico 16	<i>A. javanicus</i> (?)	45	57	33-48	45-61
Mexico 17	<i>A. javanicus</i>	43	57	34-48	46-61
Cuba 4	<i>A. moniliformis</i>	35	60	33-39	55-66
Mexico 46	<i>A. moniliformis</i>	35	63	31-38	54-70

It is evident that the resistant sporangia of the Cuban isolates of *A. arbuscula* are considerably smaller than those of Mexican collections of the same species, or for that matter, smaller than those of any of the 31 isolates of *A. arbuscula* previously studied by the author (Wolf, in press). This size difference is great enough to be considered by Emerson, in a forthcoming extensive monograph of the genus, as worthy of varietal significance.

Likewise, the resistant sporangia of the Cuban isolate of *A. javanicus* are smaller than in any isolate of this species previously studied by the author. In addition to Cuba, the known western hemisphere distribution of *A.*

javanicus includes Mexico, Texas, California, and Utah-Arizona (Wolf, in press), so that the present find represents a considerable extension in the range of this form.

A. moniliformis, originally described from North Carolina, is now known also from Mexico and Cuba as well. Resistant sporangia of collections from all of these localities are most remarkably similar to each other in size. Further studies of other tropical regions may well result in the discovery of additional localities in which the two rarer species are to be found, and perhaps also may bring to light forms which are at present completely unknown.

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